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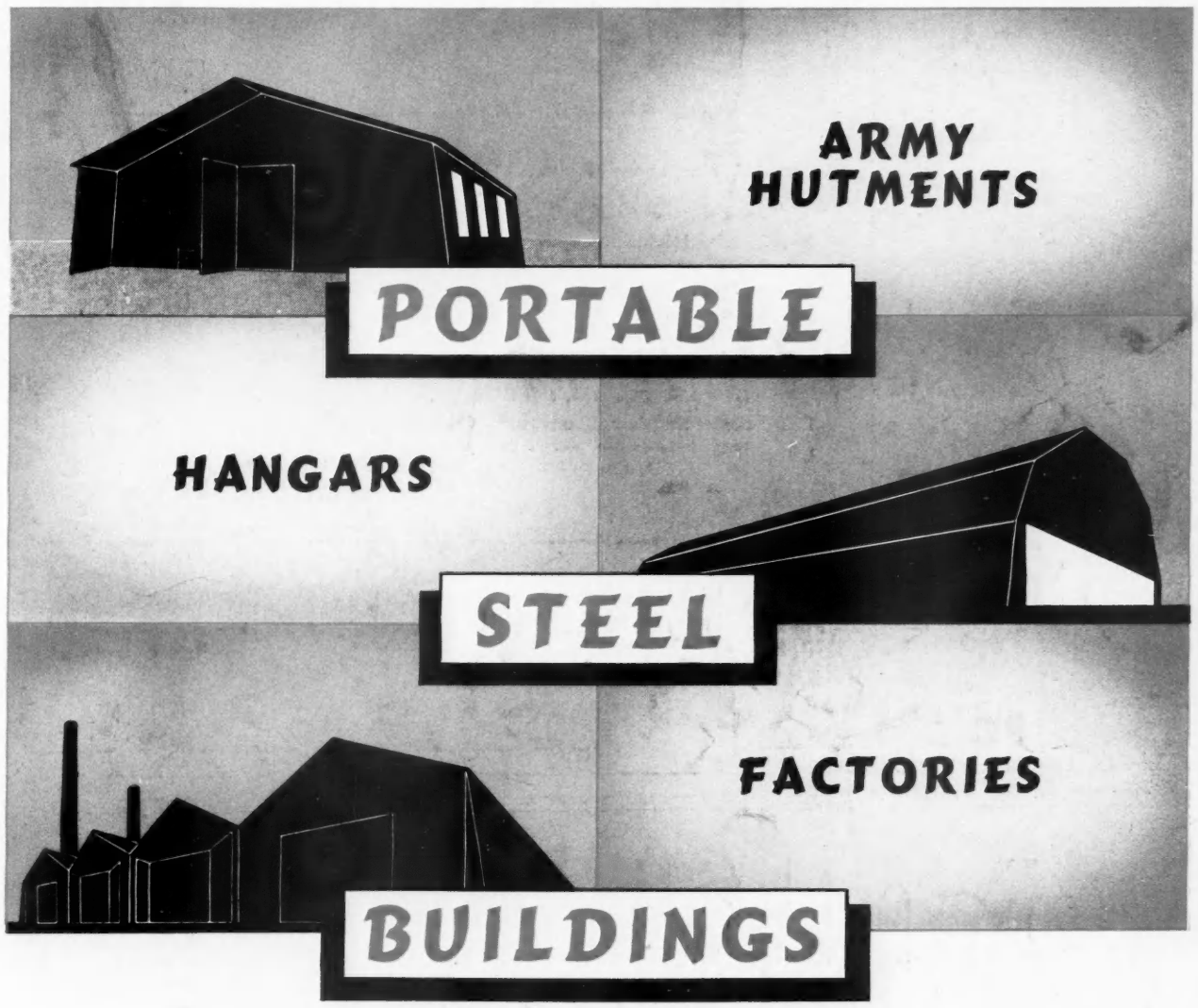


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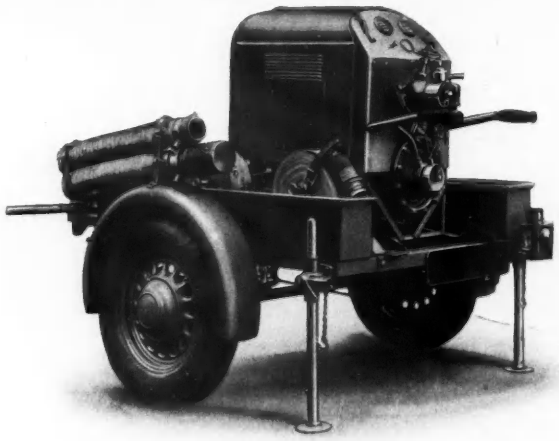

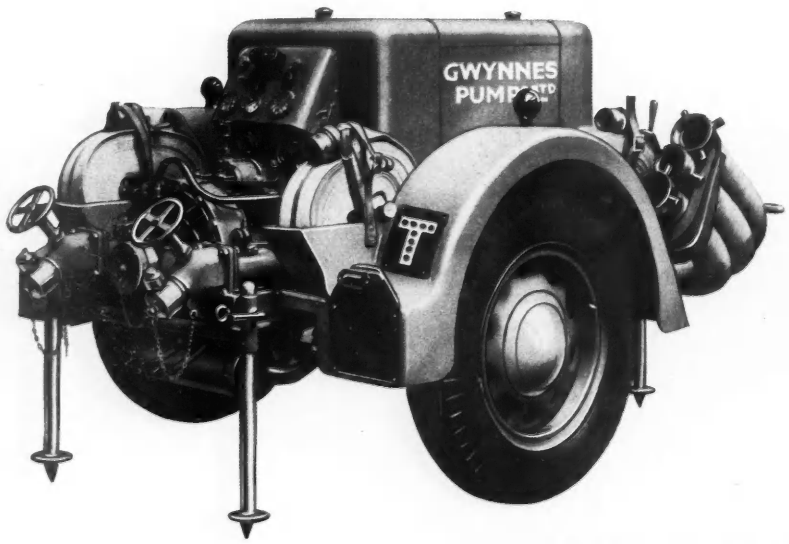


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# A Seven-Day Journal

### The First Naval Battle

LATE on Thursday evening, December 14th, came the first Admiralty report of the naval engagement on Wednesday in the South Atlantic, off the mouth of the River Plate, in which the German armoured cruiser, the "Admiral Graf Spee," was attacked by the British cruisers, "Exeter," "Ajax," and "Achilles," and after suffering severe damage was forced to seek refuge in the harbour of Montevideo. The casualties on the German ship numbered 36 dead and 60 wounded. The "Admiral Graf Spee" was the third ship of the 10,000 ton "Deutschland" class, and was armed with six 11-in. guns, mounted in three's in two turrets, eight 5·9-in. guns, and smaller armament. Her belt of armour had a thickness of 4in. The hull was welded, and her propelling machinery comprised a twin-screw arrangement of M.A.N. geared double-acting, two-stroke oil engines, four 6750 S.H.P. engines being geared to each propeller through Vulcan hydraulic couplings. The total horse-power was about 54,000 S.H.P., corresponding to a speed of 26 knots. All the British cruisers which took part in the engagement are smaller in displacement, more lightly armed, and have lighter armour. The "Exeter" was completed at Devonport Dockyard in 1931 and has a displacement of 8390 tons. Her Parsons 80,000 S.H.P. geared turbines give her a speed of 32 knots, and she carries six 8-in. guns besides smaller armament. The "Ajax" and the "Achilles" are both of the "Leander" 7000 ton class, and were completed in 1933 and 1931 by Cammel Laird and Vickers-Armstrong respectively. They carry eight 6-in. guns, and are propelled by Parsons geared turbines of about 72,000 S.H.P., corresponding to a speed of 32·5 knots. The reports of the fight, and the stories told by the survivors of nine British ships, who were imprisoned on the "Graf Spee," stress the incredible manœuvres and the inconceivable audacity of the British ships which, often firing through smoke screens, recorded many direct hits. In his report to the Uruguayan Authorities, Captain Langsdorf, the commander of the "Admiral Graf Spee," states that he was handicapped by having to fight on "three quarters," and pays tribute to the gunnery and the manœuvring of the British cruisers, which caused him to break off the fight and go into Montevideo harbour. The King has recognised the gallant and successful action fought by the British ships by conferring the K.C.B. on Commodore Harwood, who has been promoted to Rear-Admiral, and the C.B. on Captain W. E. Parry of H.M.S. "Achilles," Captain C. H. L. Woodhouse of H.M.S. "Ajax" and Captain F. S. Bell of H.M.S. "Exeter." We regret to have to record the loss of 72 officers and men in the engagement.

### The "Admiral Graf Spee" Scuttled

ON docking in Montevideo on Wednesday night, after a running fight of 14 hours along the Uruguayan coast, the "Admiral Graf Spee" began to disembark her wounded and dead, and the captains, chief engineers, and other officers who had been taken from the nine British ships sunk by the raiding cruiser were released. These ships were the "Clement," "Newton Beech," "Ashlea," Huntsman," "Trevanion," "African Shell," "Doric Star," "Tairoa," and "Streonshalh." Arrangements were immediately made with the Uruguayan authorities for the repairing of the battered hull in such a way as to render the cruiser seaworthy. The time allowed finally expired on Sunday evening, and during that day repairs by welding were hurriedly completed, and 700 members of the cruiser's crew were transferred to the German cargo ship "Tacoma" which was lying in the harbour. About 6.30, the "Admiral Graf Spee" began to manœuvre, and was headed south to the outer port. She was followed by the "Tacoma." Detachments of the crew which still remained on the cruiser were put off at intervals on the ship's launches as she steamed down the river. The ship was brought to rest in the main channel and was blown up by a mine placed in the magazine, which was detonated by pressing a button on the end of a long cable taken to one of the ship's launches in which Captain Langsdorf and his officers stood at the salute. Following the explosion, flames quickly enveloped the ship, and the cruiser settled down. The wreck will, it is feared, prove a serious hindrance to port traffic. The German officers and crew returned to Montevideo in the "Tacoma" and the Argentine gunboat "Liberatad," some of the officers going on to Buenos Aires. On Monday afternoon it was officially announced by the Admiralty that one of the Köln class of German cruisers was sunk by the British submarine "Ursula" at the mouth of the River Elbe on Thursday, December 14th. This class of cruiser, of which there are three, the "Köln," the "Karlsruhe," and the "Königsberg," has a displacement of 6000 tons and is armed with nine 5·9-in. guns and three 3·6-in. guns, and carried two aircraft. At the time of the attack the cruiser was, it is stated, screened by six destroyers. In his broadcast on Monday night, Mr. Winston Churchill gave some particulars of the voyage of the submarine "Salmon." In the week ending December 17th, she first torpedoed one of the larger German U-boats. Next she encountered the "Bremen," but abstained from torpedoeing her. Lastly she met the German Fleet proceeding to sea, and fired six torpedoes, hitting a 6000 ton cruiser with one, and another cruiser with two. These cruisers may or may not have been able to limp home. The German fleet abandoned whatever enterprise it had in view, and returned home.

### The Railways (Demurrage Charges) Order, 1939

As foreshadowed in his statement in the House of Commons on Wednesday, December 6th, the Minister of Transport made on December 14th, under the Defence Regulations, 1939, the Railways (Demurrage Charges) Order, 1939, which authorises the Railway Companies on and from December 15th, 1939, to increase the demurrage charges for railway wagons, containers and sheets, and reduce the "free time." Broadly speaking, the effect will be to reduce to 24 hours the "free time" allowed for loading or unloading, and to double the demurrage charges payable for detention beyond that period. The Order provides that Sundays, Bank Holidays and the period from 12 noon to midnight on Saturdays shall not be included in the "free time," and that when the "free time" commences after 12 noon on any day, the rest of that day shall not be included. Until March 31st, 1940, registered coal merchants will be allowed 48 hours instead of 24 hours for unloading wagons. By that time they will be expected to have made such arrangements as will enable them to comply with the general requirements that wagons should be released after 24 hours. The Order provides that the charges and free periods set out in the schedule to the Order shall not apply to wagons used for the conveyance of coal, coke, or patent fuel where the operation of such wagons is regulated under a system of control agreed between the railway companies and the interests concerned, and approved by the Minister of Transport. The Minister has given an assurance that the Order will be administered with due regard to any genuine difficulties which traders and agriculturalists may have in giving strict compliance, provided they can show that by the institution of a proper control of their forwarding arrangements, and where practicable and necessary, the re-organisation of their unloading and storage arrangements, they have taken all reasonable steps to adjust themselves to the needs of the situation.

### Loss of the Thetis

WHEN the public enquiry into the cause of the loss of the submarine "Thetis" was continued on Wednesday, December 13th, no further evidence was presented, and the counsel representing various interests were given the opportunity to make speeches. The Attorney-General, Sir Donald Somervell, K.C. spoke first, and was followed on Thursday by Mr. Reginald Paget, counsel for the relatives of an apprentice who lost his life in the disaster, and by Mr. D. MacIntyre who appeared for the Amalgamated Engineering and Electrical Trade Unions on behalf of relatives of civilian engineers and electricians lost in the submarine. The Attorney-General said that Lt. Woods saw on the trim sheet the word "full" against tubes Nos. 5 and 6, but on testing them he came to the conclusion that there was only a little water in them. Leading Seaman Hambrook reported that the control levers were in a position which meant that the bow caps were shut. These two men then made two assumptions. One was that the tube, the opening of the inner door of which was the cause of the disaster, was empty and the other that the bow cap was closed. The essential cause of the disaster was the fact that the bow cap was open. He considered the theory that someone unfamiliar with the mechanism jolted into the operating lever and then returned it to position ought not to be dismissed. Mr. Paget thought that the theory of the accidental movement of the lever should be rejected. He said the fundamental cause of the disaster was "the evil and ill-defined responsibility which was found in every phase of the case from the building of the submarine right down to the failure to salve her in time to save the lives of the men." Mr. MacIntyre made the third suggestion that the lever was moved voluntarily by Leading Seaman Hambrook. It was he that turned on the power. He knew that the only reason for having the power on would be to produce a position in which the bow cap could be opened and anticipated that the next order would be to open the cap. The ship was a new one and the levers were difficult to move because they were stiff. He suggested that Hambrook moved the levers slightly in order to ease them, and in the case of the one under consideration, moved it rather too far, so that the cap "opened sufficiently to start a creeping movement." The cap would not then have shut when the lever was put back to neutral. On Friday, Mr. A. T. Miller, K.C., acting for Cammell Laird, Ltd., constructors of the submarine, expressed the hope that his Lordship, in making his report, would make plain what he ventured to think was plain, that in no detail had the builders forfeited their high reputation. In a final speech the Attorney-General said that he saw no grounds on which it could be suggested that the divided control of which Mr. Paget had spoken was something that ought to be looked into, and was something which was responsible for muddle. There was no system under which misunderstanding might not arise between human beings. A series of unconnected events seemed to have conspired together to produce the disaster. It was clear that the disaster was not due to any failure of the structure, but to some mistake, the nature of which might perhaps never be completely clear. Mr. Justice Bucknill indicated that in due course he would submit his report to the proper authorities.

### Flood Gates on Tube Railways

As from last Sunday, December 17th, services on the tube railways of London have been almost normal. Out of the fifty-one stations at which protective works had to be carried out, only two still remain out of service, Trinity Road and Maida Vale. With the completion of the work at Charing Cross, interchange facilities between the District, Northern, and Bakerloo lines became again available. This station had to be closed on the outbreak of war in order that flood gates could be installed to prevent the flooding of the tunnels from the Thames in case of damage. In an article in our issue of December 1st, we gave an illustrated description of these gates. They are designed to resist a pressure of 800 tons, and each is built up of steel, with an overall thickness of 13in. and weighs just under 6 tons. They are set in a framework of cast iron against the headwalls of the station platforms alongside the tunnel mouths. They are moved electrically or alternatively by hand power, the time required to close the gates being one minute in the first case, and 4½ minutes in the second. Special arrangements have been made for transmitting warnings of raids to attendants who are on duty continuously, and indications are provided to show whether there are trains in that part of the tunnel which is to be closed off. At other stations, provision has had to be made against the possibility of flooding from burst sewers, water mains, &c. The types of gates adopted have varied in accordance with the conditions at each point.

### Transport in Wartime

IN a broadcast speech on December 13th, Capt. Euan Wallace, Minister of Transport said that the first danger to be guarded against when war broke out was the chance of our transport being tied up by enemy action. There was every likelihood that hostilities would start with a massed attack from the air on our docks, railways, bridges, and important road junctions. Some parts were more vulnerable than others, and a scheme had been devised by which certain homeward-bound ships were immediately diverted to safer harbours. This machinery was still in daily operation. There was also the possibility of hits on a railway junction, a rail or a road bridge, or a main trunk road. Where road material was not readily available, dumps had been formed by the use of which local authorities would be able to get any damaged road into working order. Bridge parts specially designed to be interchangeable for varying spans, and capable of rapid erection had been accumulated at various centres. The railways had made similar arrangements for their bridges, and permanent way. The fact that none of these emergency repairs had yet been required was no guarantee that we should continue to be immune. But the main task of the Ministry was something more positive than the repair of damage. It was to ensure that the transport system was so organised that it could carry the heavy additional burdens thrown upon it by the war. The four main-line railway companies, and the L.P.T.B. had been brought under Government control; the working of each of the principal ports had been placed in the hands of a Port Emergency Committee, on which various interested bodies were represented, and heavy use was being made of the canals, for advice upon which an Advisory Committee had been appointed. In road transport the various units had been organised into groups so that if one trader had one or more of his vehicles taken by the Army, the organiser of the group was able to arrange for other vehicles in the group to help him out. It was his policy to impose no restriction on road transport that was not required by the necessities of war.

# Salvage of U.S. Submarine "Squalus"

No. II

(Continued from page 586, Dec. 15th)

PREPARATORY work for the salvaging of the "Squalus" was started a few days after the rescue work was concluded. The refloating of the submarine was accomplished with the aid of submergible pontoons. Some of the pontoons used were utilised during 1925–26 in raising the "S-51" which was sunk in the open sea off Block Island, R.I., The "S-51" was travelling on the surface on a clear night when she was struck by a coastal steamer, and sent to the bottom, September 25th, 1925, in water 132ft. deep. The recovery of the ship was the first time that submergible pontoons had been used in such deep water; and severe winter storms and the inherent difficulties of the task spread the work over a period of something more than nine months. The salvage of the "S-4," in 1927–28, made use of the same pontoons; and the craft was lifted and delivered at the Navy Yard, Boston, Mass., in about three months from the date of sinking—the depth of water being 102ft. The experience gained in the cases of "S-51" and "S-4" was employed to advantage in salvaging the "Squalus"; but the larger size of that vessel and the greater depth of her submergence added considerably to the problem of her recovery.

The situation presented these outstanding factors: A large part of the craft had ploughed into the bottom mud when she settled stern first; the four after compartments were known to be virtually filled with sea water that had found entrance by way of the high induction valve; all compartments forward of the bulkhead at the after end of the control room were dry; and the ballast tanks had been blown as soon as water had been reported entering the ship by way of the open induction valve. None of the Navy's divers had previously been required to work in water at a depth of 240ft.

Foreseeing the ultimate need of diving operations at depths much greater than 200ft., the Navy has, for some years, been engaged in research work at its Experimental Diving Unit, Navy Yard, Washington, D.C., and the men under training there have been subjected to pressures equivalent to depths of water up to from 400 to 500ft.; and experimental dives in the diving tank have been carried out with the men breathing a synthetic atmosphere of oxygen-helium, and at pressures corresponding to a maximum of a submergence of 500 feet. They were not called upon to do any work under those conditions. Some of the divers immediately available on the "Falcon" at the start of the rescue and salvage work were the best qualified at the disposal of the Navy. Difficulties were encountered well-nigh at the very start of preparatory salvage activities and when the oxygen-helium mixture was supplied to the divers.

On May 29th, with the sea water at a temperature of 38 deg. Fah. on the bottom, the divers complained of frosting within their helmets and clogging of their air lines. The trouble was primarily due to the water vapour within the divers' helmets and to the sudden expansion of the artificial atmosphere when discharged into the helmets. At the same time, with the men working somewhat strenuously, the amount of $CO_2$ exhaled by them was relatively high, and that gas affected them. This was overcome by controlling the expansion and by passing the atmosphere in the helmet continuously through a small apparatus capable of removing the exhaled $CO_2$. The oxygen-helium mixture, especially when the water is cold, chills the diver more than air, and this action has been offset by the Navy by clothing the men in an underdress that covers their bodies, hands, feet, and heads, with the exception of their faces. To increase their warmth these suits are heated electrically, and the resistance wires are insulated with a glass-fibre textile. The suits are not needed in warm water.

The oxygen-helium atmosphere was prepared at the Portsmouth Navy yard, where the helium was delivered in flasks at a pressure of 1800lb., and combined in other bottles with the oxygen and sent out to the "Falcon" at a pressure of 1100 lb., where, after passing through a reducing valve, it was delivered into the air lines of the divers. Notwithstanding the "Falcon" had a maximum of 49 divers available, the practice was to have but two men down at a time, and usually to keep them on the bottom only for a short while during each descent. With a dive of 20 mins. at a depth of 240ft., the decompression period, if the diver used only air, would be 95 mins.; but with the oxygen-helium mixture this could be reduced to 63 mins. The practice adopted was to bring the men up to 50ft. by stage decompression, which would average about 20 mins., then the men were taken out of the water and placed in the recompression chamber, at a pressure corresponding to a submergence of 50ft., and there decompressed while inhaling oxygen. This got the diver out of the cold water fairly quickly, and after he entered the recompression chamber he was undressed and allowed to continue his period of decompression in a comfortable atmosphere. During the weeks of diving work on the "Squalus," there were only two attacks of bends, and both occurred because the men worked too hard and too long in each case in connection with the jobs assigned them. Both men responded quickly to treatment, and were soon again ready for service.

Before describing the pontoons and their uses in lifting the "Squalus," and sustaining her during the journey to port, some details about the salvage vessel, the U.S.S. "Falcon" should be given in advance. The "Falcon" was built as a mine sweeper during the World War, and later assigned to the Naval Submarine Base, at New London, Conn., for rescue and salvage service after being equipped for that somewhat specialised work. She has a length of 186ft., a maximum beam of 35ft., and a displacement of 1440 tons. She is equipped with a vertical triple expansion engine driving a single screw, and has a speed of 14 knots. Her complement is 62 officers and crew. She has two oil-burning boilers. Her main engines develop 1400 H.P. To meet the requirements of rescue and salvage work, the "Falcon" carries a diversified compressor plant of seven units capable of providing air at pressures ranging from 150 lb. per square inch to 3000 lb. per square inch, and there are aftercoolers and heaters for fitting the air for the divers when working especially in cold water where moisture in the air supply might give trouble. The ship has extra wrecking pumps, special winches fore and aft of the deck house, and bitts wherever they would be useful for handling more or less numerous lines. She also is provided with a recompression chamber, placed within the deck house, that has an internal diameter of 6ft. 6in., and a length of 14ft. 6in.—large enough to accommodate 20 men if necessary. There are four air banks, two of which are composed each of seven bottles, while each of the two other banks is made up of six bottles. Air is led from the banks through reducing valves to accumulators, and distributed thence to the air lines either for divers or for salvage operations. There are three different manifold units for the distribution of compressed air, and these units have a total of 44 connections. The manifolds are strategically situated where they had been found most convenient in service; and the diving and salvage manifolds may be used independently or cross-connected if conditions so require.

The diving dress, used for work with the oxygen-helium mixture, differs from the regular diving dress in that the helmet and the breast-plate are in one piece, and the rubber suit is secured to the breast-plate section, not by bolts, but by means of a wire cable, with threaded ends, that can be drawn together so as to secure the suit to the metal in a groove provided for that purposes. The oxygen-helium mixture was delivered to the divers only when working at a depth of 160ft. or more; and from 160ft. or less, the divers received straight air.

The pontoons, Fig. 5, used in salvaging the "Squalus" were of 60 ton and 80 ton capacities; and eight of the larger units were employed. Each 80 ton pontoon has a diameter of 13½ft., and a length of 32ft., and is sheathed with 3in. planking enveloped by wire-rope bands in addition to the other means of securing the sheathing to the steel cylinder. Each 60 ton pontoon weighs 30 tons, and each 80 ton pontoon weighs 42 tons. The larger pontoons have been modified since they were last used in raising the "S-4," at which time all the pontoons were divided into two separate compartments by a single central watertight bulkhead. Both the "S-51" and the "S-4" were brought to the surface by a single lift, and the pontoons were connected to the chain-cable slings beneath those boats by first being sunk to the sea bed close alongside the submarines. The slack of the slings was drawn up through the two hawsepipes that vertically pierce each pontoon on the centre line, and then the chains were held in place by sliding nickel-steel toggle-bars through the links just clear of the upper lip of the hawsepipes. This locking device, satisfactory as it is, cannot be used to hold wire cables; and most of the lengths of each lifting line above the cradle slings for the "Squalus" were of steel cables—the lower part, within the range of the three levels of the pontoons, was of 2½in. diameter galvanised wire rope, and above the topmost line of pontoons that rope, by a 7ft. tapered splice, was joined to an uncoated wire rope 1in. in diameter that extended above the surface to the salvage vessel. To grip the wire rope at the top of each hawsepipe, there was developed what was nicknamed a "flower pot." Each flower pot consisted outwardly of a sturdy, steel, downward-tapering body, with a flanged base wide enough to overlap the lip of a hawsepipe. Inside this casting, circular in cross section, was secured a series of rollers or runners, and between the runners and the wire rope could be inserted three large curved wedges that would be drawn down and tight into the flower pot, gripping the cable, the instant a pontoon exerted its buoyancy and tried to climb along the lines passing through it. The flower pots functioned as designed.

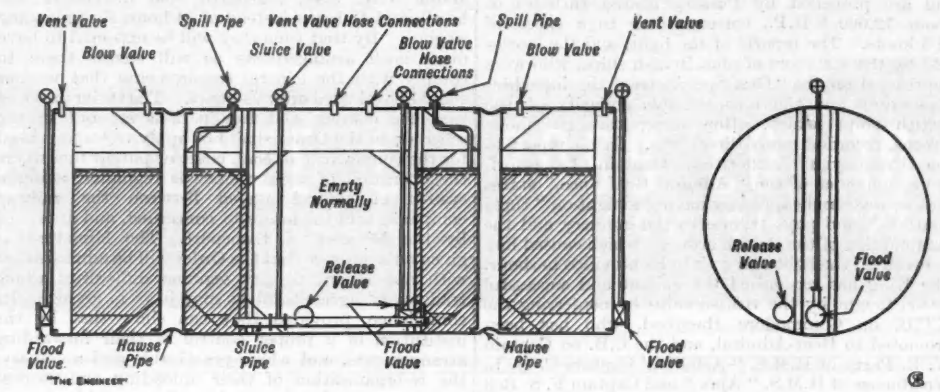



FIG. 5—GENERAL ARRANGEMENT OF LIFTING PONTOON

The 80 ton pontoons, Fig. 5, that helped to salve the "Squalus" were divided longitudinally into three watertight compartments by two transverse watertight bulkheads—the smaller central compartment, when empty, assuring a positive buoyancy of 10 tons. This was the buoyancy given each pontoon after it had been secured at its assigned elevation submerged. While each compartment had its own venting and blow connections and flooding and release valves, at low points, the fine control of reserve buoyancy at the time of blowing was assured by the use of "spill pipes," which were merely extensions into the pontoon compartment of pipes that could be moved vertically so that the bottom outlet would be at any chosen level inside the pontoon. When water was free to enter the pontoon, the air pocket above the bottom of a spill pipe served to keep the admitted water at the desired level. At the bottom of the central compartment, and connecting the two end compartments, a sluice pipe,

with a sluice valve controlled from the top of the pontoon, put those two end compartments in communication when the sluice valve was opened. This arrangement was important in completely blowing the end compartments when a pontoon was arranged parallel with the centre line of the submarine, and the vessel was likely to rise first at one end. Without the sluice pipe, unbalancing residual water would remain in the higher end of a pontoon when air could escape by the valve that functioned both for flooding and for blowing. The sluice pipe could be counted upon to drain the water from the high end to the low end, from which it could be blown out by the compressed air. Fig. 6 illustrates the purpose of the sluice pipe and valve. "A" shows how water would remain in the up-ended compartment, and air escape by the flood valve if the sluice pipe were closed. "B" illustrates how water would flow from the up-ended compartment through the sluice pipe and into the lower tank from which it could be driven into the sea when the pontoon is blown, even though the pontoon was not on an even keel.

The centre compartment has, of course, its own flood valve and relief valve. The flood pipe is led to the centre compartment through one of the end compartments; and this arrangement permits rapid unwatering of the centre compartment, but was seldom used because the centre compartment was usually kept empty during operations, save for water entering it as unavoidable leakage. The use of three compartments instead of two proved advantageous during the work on the "Squalus." It is also reported that a single blow line did double service, instead of using separate blow and venting lines—one line by alternate valving at the manifold on the "Falcon" permitted either blowing or venting.

Salvaging preparations started about June 1st, and the first lifting operations took place on July 13th. The most troublesome job of getting ready for that lift was to clear the way for passing the 90ft. chain cable slings beneath the stern of the "Squalus" where her body had been forced deep into the mud of the water bed. That work is usually done by tunnelling with a water jet directed by a diver. The nature of the bottom mud, and the depth of the submergence made the work hazardous and increased the dangers of cave-ins. Two of the salvage officers, Commander A. I. McKee, of the Construction Corps, and Lieutenant Commander Charles B. Momsen, who has done important work in diving researches, devised a tunnelling apparatus which could be directed by a diver stationed on the deck of the submarine. The tunnelling lance consisted of a self-propelling nozzle attached to a succession of curved sections of piping that ranged in lengths of from 8ft. to 18ft. The nozzle was secured to a pipe-section 1in. in diameter, and the following sections increased gradually until the last section was 2½in. in diameter. The larger section slipped over the smaller one to make a joint, and the contiguous ends were held together by a toggle pin. At intervals, the pipe sections were perforated to permit the lateral escape of the high-pressure water to overcome skin friction from the surrounding mud, and to make it possible, if so desired, to retract the lance. The water-pressure in the lance varied and reached a maximum of 300 lb. per square inch. At times, high-pressure air was blown through the lance to clear the line and to aid in the excavating.

The self-propelled nozzle has been used before by the Navy. The hood of the nozzle is designed so that some of the discharged water escapes rearward to neutralise and even to overbalance the rearward recoil of the direct excavating stream. The diver's job was to keep the curved pipe of the lance down along the descending side of the submarine and to add extending lengths as needed. He worked entirely from the deck of the submarine; and 1¼in. hose delivered both the air and the water for the lance. In this manner, the stern tunnel was excavated rapidly and safely. When the nozzle reached the surface of the bottom on the other side of the vessel, a small wire cable was shoved through the lance to serve as the lead for the other lines that finally pulled each of the three after slings from the "Falcon" down under the "Squalus" and back again to the salvage vessel. Each sling, with its 2½in. diameter chain cradle length, and the adjoining sections of 2½in. diameter wire cable, and the terminal lengths of 1in. diameter wire cable were assembled complete on the "Falcon" before lowering and passing under the "Squalus" and up again to the surface. Thus the placing of each sling was a single and continuous operation. The slings were rove through the hawsepipes of their respective pontoons before the pontoons were sunk in place. For the first two lifts, the pontoons were arranged athwartships to the submarine, and for the final lift the pontoons were secured parallel to the centre line of the "Squalus."

At each end of a pontoon, before it was ready for sinking, was secured an 8in. manila hawser, and those two lines controlled the rate of sinking, and the depth at which a pontoon was held for securing to either the chain cables or to the attached 2½in. wire-rope cables. Each lowering line of a pontoon was marked with a painted band at regular intervals, and the bands at each distance were painted a distinguishing colour to facilitate identification by the men lowering away from two bitts. This provision made it possible to keep a check on the submergence of each end of each pontoon and, correspondingly, on any other pontoons that had to be arranged at any given depth. When sinking a pontoon, enough water was placed in the two end compartments to give the cylinder a negative buoyancy of from 4 to 5 tons—the centre compartment being kept empty. With that dead weight, it was found possible to handle a pontoon readily and to get it quickly down to its assigned depth, where it was secured to the cable by a "flower pot." In the last lift, where the chain slings were brought up through the hawsepipes of the pontoons, the familiar toggle bars of nickel steel were passed through the links of the chain at the top lip of the hawsepipe to hold the pontoon in place. When attached to the slings, the pontoons were blown just enough to give them sufficient buoyancy to sustain the weights attached to them.

The first effort to lift the "Squalus" failed to conform to the plans when the pontoons were blown on July 13th. What happened is thus briefly described in the report issued by the commandant of the Portsmouth Navy Yard: "Lifted stern of 'Squalus' with five pontoons about 85ft. clear of bottom. Then lifted bow with two pontoons, blowing ballast tanks forward. Both pontoons came to the surface followed by the bow. Forward sling carried away and bow sank. One sling aft and two lower pontoons on sling surfaced. Stern sank with remaining pontoons, possibly in a damaged condition. (See page 616). Think 'Squalus' on even keel on bottom. Two chains still remain under stern." The mishap was due to lack of control of the water ballast in a large tank forward that was only partly blown when the bow lifted; and the sudden increase in excess buoyancy, due to the expanding air under released hydrostatic pressure, caused the remaining water to surge downward toward the stern as the bow rose. The bow came up very quickly from a depth of 240ft. and projected above the surface of the sea almost perpendicularly for a brief while, before settling back to the sea bed. Clearing up the tangle underwater, and re-arranging the slings and the pontoons took nearly a month before the next lift could be undertaken.

The second lifting operations were carried out successfully on August 12th, and ten pontoons were used on that occasion—six above the stern and four above the bow, arranged at three levels and with the top-most groups approximately 80ft. below the surface. (See Fig. 7). The numerals indicate the pontoons used for the different lifts. For the first and the second lifts, the pontoons were placed transversely to the centre line of the submarine. On the third lift, the four pontoons were arranged longitudinally, two forward and two aft, one on each side of the vessel.

The 10 pontoons had a combined lifting capacity of 760 tons. In blowing them the work was done first on the top pontoons, and then on the succeeding groups below. When the uppermost pontoons, forward and aft, reached the surface, then the "Squalus" was well above the sea bed, and the work of towing her and the pontoons shoreward began. The ship, herself, was lightened by blowing some of her ballast tanks, both forward and aft. The "Squalus" was towed stern first, and with her bow held at a slightly greater depth so that the latter would ground first on reaching shoaler water. The head of the towing line was the U.S.S. "Wandank," a Navy tug, which had a hawser leading down to the stern of the "Squalus" and a line secured to the surfaced pontoons above the stern. At the rear of the procession was the "Falcon," with a hawser secured to the bow of the submarine and lines connecting to the nearby floating pontoons. At the same time, the "Falcon" was connected with all the pontoons, and the "Squalus" by a total of nearly 40 air hoses. Moving very slowly, the flotilla had covered only about half the projected distance when the stern of the submarine hit the sharp rise of an uncharted mud bank, and was brought to a halt in water 160ft. deep.

Five days later, with five pontoons at the stern, and four at the bow, arranged in each case at two levels, the "Squalus" was again lifted without a hitch and towed under favouring conditions about 5 miles to a point within the shelter of the Isles of Shoals, and grounded in water 90ft. deep. Between August 17th and September 13th, work on the "Squalus" was twice halted by severe storms. When the weather permitted, the pontoons and slings were put in place for the concluding lift—two pontoons forward and two aft, close to the hull and arranged longitudinally instead of transversely, as previously. The submarine was brought to the surface on September 13th, and the salvage flotilla, as described before, made the long

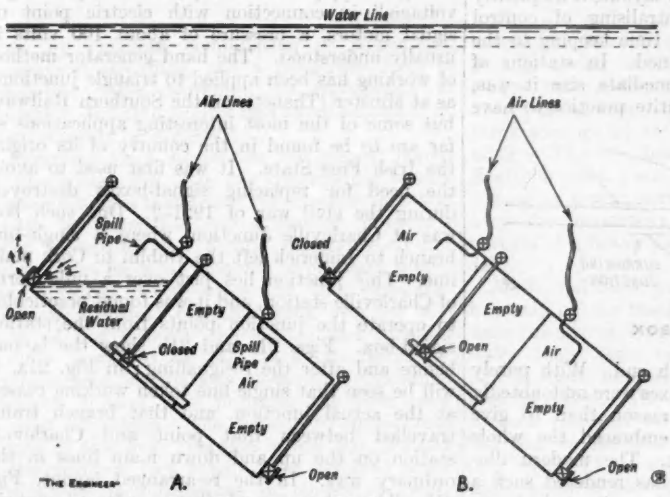



FIG. 6—ILLUSTRATING PURPOSE OF SLUICE PIPE

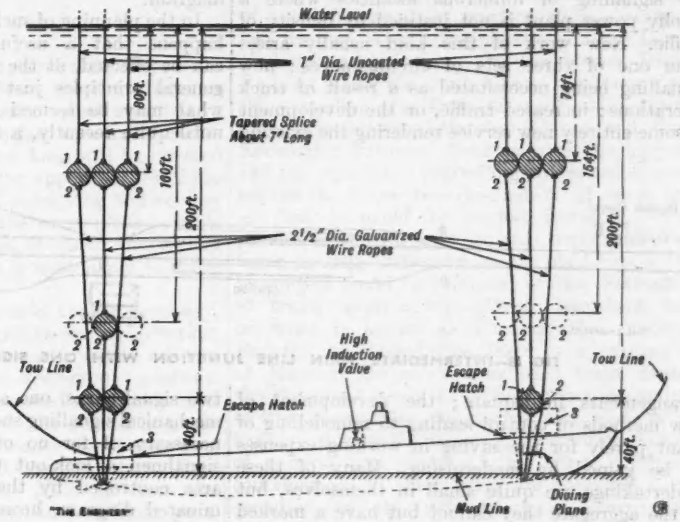



FIG. 7—ARRANGEMENTS FOR LIFTING, AUGUST 12TH

and concluding run of about 9 miles to the mouth of the Piscataqua River, and thence up that swiftly-flowing stream to the Navy Yard—another tug helping to get the vessel into port. She reached dock about 9 p.m. (See page 616.)

The "Squalus," when placed in commission, is said to have cost approximately $4,000,000; and is one of an identical group of 10 boats. She is now in dry dock and undergoing reconditioning. The day following her return to the naval station, the bodies of 25 men were removed from the compartment connecting with the after escape hatch. One of the crew was missing. His body is believed to have got out while the boat was submerged through a hatchway that had probably been kicked open accidentally by a diver working on the craft.

Rear Admiral Cyrus W. Cole, U.S.N., commandant of the Navy Yard, Portsmouth, N.H., was in charge of the operations in connection with the rescue and salvage work on the "Squalus"; and Lieutenant Commander Floyd A. Tusler, of the Construction Corps of the Navy, acted as salvage officer of the "Squalus" Salvage Unit. The U.S.S. "Falcon," which did splendid work, is commanded by Lieutenant George A. Sharp, U.S.N. The Navy drew upon all available resources along the Atlantic seaboard in dealing with the problem, and the pontoons were obtained from the Naval Submarine Base, New London, Conn., and the Brooklyn Navy Yard; and the helium was delivered from the Naval Air Station, Lakehurst, N.J. During most of the time that the rescue and salvage work was underway, the U.S. Submarine "Sculpin," a sister ship of the "Squalus," was at the scene of the accident where she served to familiarise the divers with the various parts of the sunken boat with which they would have to work mostly by the sense of touch.

# Modern Railway Signalling Practice

## No. III

(*Continued from page 583, Dec. 15th*)

IN continuing this study of modern control methods consideration must now be given to the signalling in numerous localities where a wholly power plant is not justified by density of traffic. New work of this kind usually arises from one of three sets of circumstances; new signalling being necessitated as a result of track alterations; increased traffic, or the development of some entirely new service rendering the existing arrangements inadequate; the development of new methods of control leading to remodelling of plant purely for the saving in working expenses to be gained by modernising. Many of these undertakings are quite small in themselves, but in the aggregate they cannot but have a marked effect on train operation in general. In contrast to the big concentrations that were dealt with in the second article of this series a goodly proportion of the layouts now to be considered are to be found in unexpected, out-of-the-way places, such as the Highlands of Scotland and the country districts of Eire, where the centralising of control on a small scale has led to some very interesting signalling works.

The largest installations coming within this rather broad category are to be found at terminal stations and main line junctions where service frequency does not warrant full colour-light signalling, but needs something more in the way of safeguards than purely mechanical working can give. The system used widely on the Southern Railway is often termed "electro-mechanical," since it forms a combination of mechanical operation with electric locking. In general it may be said that all the signals are semaphores operated by wire, and that all the points are rod worked; but to give the additional protection of constant interlocking between the traffic and the apparatus in the signal-box the whole layout is track-circuited. All the safeguards of a complete all-power installation are provided, but with the comparatively modest capital outlay (and electricity bill) on the track circuits only, instead of, maybe, a couple of score of powerful point motors, and all the accessories of colour-light signalling. The signal-box is, of course, equipped with an illuminated track diagram.

In the planning of such new layouts it frequently happens that a useful centralising of control can be effected, at the same time keeping to the general principles just outlined. In stations of what may be termed intermediate size it was, until quite recently, a favourite practice to have two signal-boxes, one at each end. With purely mechanical signalling such boxes were undoubtedly necessary, if for no other reason than to give signalmen a look-out that embraced the whole area controlled by the box. The modern illuminated diagram, however, has rendered such a look-out unnecessary and a box situated at one end of a station can satisfactorily control movements at the other end; the difficulties of such remote control lie in the operation of the points and signals. In most localities in England the grid makes available a power supply, and in a layout such as that shown in Fig. 18, the points lettered A and B would be motor-worked. Some of the signals, too, could with advantage be worked electrically; the distant for the direction left to right across the page indicated by the letter C, might well be almost a mile from the signal-box, though many signals are wire worked from distances nearly as great as that.

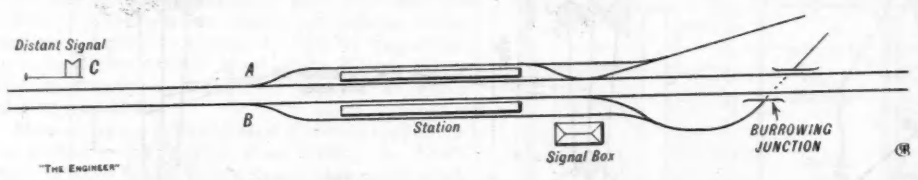



FIG. 18—INTERMEDIATE MAIN LINE JUNCTION WITH ONE SIGNAL BOX

Similar conditions, on a very much smaller scale, exist at many wayside stations in the back of beyond. Fig. 19 illustrates a typical station on a section of single line, such as might be found in the north of Scotland. The loop is made long to accommodate express passenger trains of 15 or 16 coaches, such as are run in the summer tourist season. Until comparatively recent times such loops were invariably provided with two signal-boxes, one at each end, but with modern equipment there is no need to do this. The points at X can be motor-worked, but it is unnecessary to instal complete track-circuiting, as in the case of the larger station previously considered; all that is needed is one track, as shown in Fig. 19, to protect the actual points. An electric indicator, to show the signalman whether the track is occupied or not, is the only apparatus needed for watching traffic movement, in addition, of course, to the ordinary non-illuminated track diagram. In a remote locality where no power is available the point motor, track circuits, and cabin indicators can be worked very economically from low voltage batteries, the point motor requiring not more than 30 volts to give rapid operation. The same principle can be usefully applied to the working of triangle junctions, as shown in Fig. 20. Quite apart from the saving in operating expenses, as a result of having one instead of three signal-boxes, it is clear that considerably improved working is possible where the man at A has control of the whole area, instead of the former method which relied on the successful co-operation of three men.

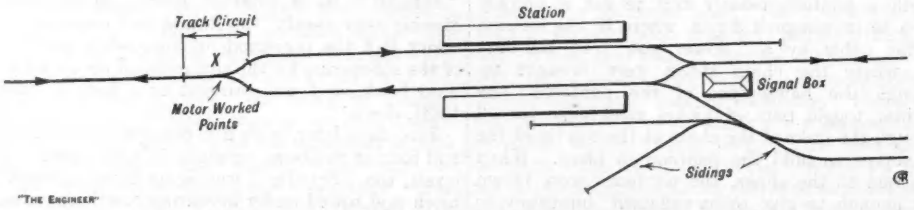



FIG. 19—PASSING STATION ON SINGLE LINE WITH ONE SIGNAL BOX

To obtain the necessary speed of operation of the low-voltage point motor a fairly large battery is needed. It is not always convenient to instal such a battery, and then, as an alternative, a hand-generator can be used to provide a high-voltage supply when required. By "high-voltage," in connection with electric point or signal motors, a pressure of about 100 volts is usually understood. The hand generator method of working has been applied to triangle junctions, as at Minster (Thanet), on the Southern Railway, but some of the most interesting applications so far are to be found in the country of its origin, the Irish Free State. It was first used to avoid the need for replacing signal-boxes destroyed during the civil war of 1921–2. One such box was at Charleville Junction, where a single-line branch to Limerick left the Dublin to Cork main line. This junction lies just over a mile north of Charleville station, and it was found practicable to operate the junction points from the station signal-box. Figs. 21a and 21b show the layout before and after the resignalling; in Fig. 21a, it will be seen that single-line token working ceased at the actual junction, and that branch trains travelled between that point and Charleville station on the up and down main lines in the ordinary way. In the re-arranged layout, Fig. 21b, all branch trains, whether to or from Limerick, use the up main line between Charleville station and the junction; this portion is track circuited, and the starting signals at Charleville station are so interlocked, electrically, with the single-line token instrument, and with the special lever used for the remote control of the points, that the route must be completely set up and correct before a train can be authorised to start. The operation of the point motor by current from a hand operated generator was really no greater a departure from previous practice than the either-direction running on the up line between Charleville and the junction, though the former attracted the greater attention at the time.

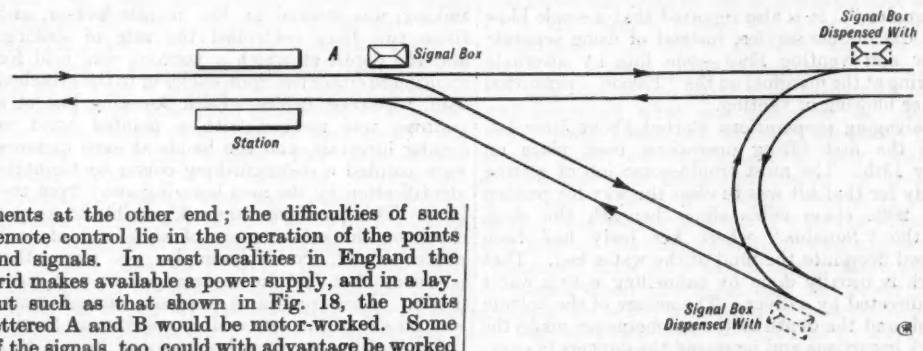



FIG. 20—TRIANGULAR JUNCTION

A novel use of the hand-generator system, also on the Great Southern Railways of Eire, was made in the resignalling of Banagher Junction, on the Portarlington–Athlone line; this included the seemingly impossible feat of "signalling" a junction without any signals whatever. Both the main line and the branch are single-tracked,

there is no station near, and the junction is just a simple turnout with no complications in the way of passing loops or sidings; Fig. 22 shows the layout. The lever operating the junction points was placed in the signal-box at Clara and interlocked with the single-line token instruments. To obtain a token for sending a train from Clara to Ballycumber the junction points must first be set correctly; then once the token is withdrawn the points are held electrically locked until the train reaches the other end of the section, and the token is placed in the instrument in the signal-box there. Similar precautions apply to working in the reverse direction, or for working to and from the branch. As an example of what can be done by judicious combination of power and mechanical signalling, and a recognised form of single-line token working, the installation at Banagher Junction, simple and small though it is, could scarcely be surpassed.

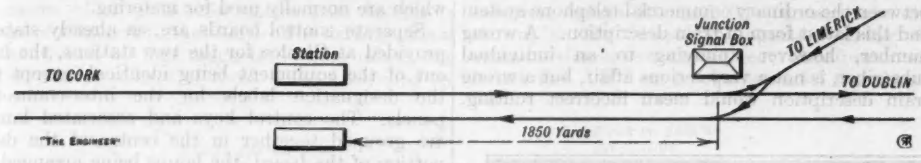



FIG. 21A—ORIGINAL LAYOUT AT CHARLEVILLE, EIRE

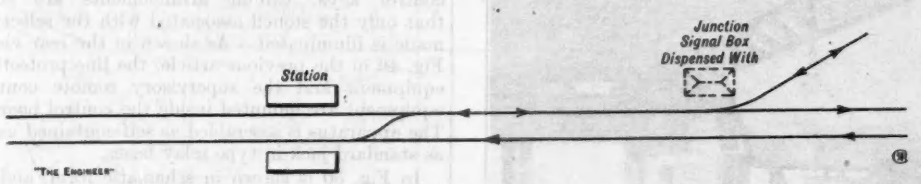



FIG. 21B—PRESENT LAYOUT AT CHARLEVILLE

Reverting for a moment to the present layout at Charleville, Fig. 21b, one outstanding feature of the working is that trains run in either direction on the up main line, and a number of them—those routed for the Dublin direction—do not carry tokens for what amounts to ordinary single-line working. Even supposing the signalman did make a mistake opposing traffic over the mile or so of line between the station and junction is fully protected by the track circuiting. In several recent installations, notably at Coleraine, Northern Ireland, this principle has been used to great advantage. The decision to concentrate control at this busy junction in one box, instead of the previous two, might have involved some considerable inconveniences in connection with the single-line token working on the 5-mile long section just south of the station; these difficulties were due, like most other signalling problems, to the wide differences existing between the track layout at one station and another. The solution was to abolish token working altogether. In the Coleraine resignalling the complete 5-mile section was track circuited and the work of the signalmen at the two ends co-ordinated by a system of electric direction levers; when the man at one end wishes to send a train he cannot lower his starting signal to do so unless the whole section is proved clear by the track circuit and the man at the far end has accepted the train by pulling over his direction lever. It would not be an economical proposition to replace all single-line token working by such a system, but its use in a case of special difficulties illustrates well how track circuiting and electric lever locking can be brought in to solve problems in what would otherwise be mechanical signalling territory.

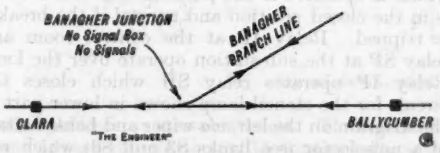



FIG. 22—LAYOUT AT BANAGHER JUNCTION

The same limited use of electrical apparatus brought a skilful solution of a different sort of problem, one connected with the running speed of trains on sections of steep or variable grading. In the first article of this series the question of the spacing of colour-light signals to preserve an even headway was considered. The same need to take into account the ruling speed of trains applies also in mechanical territory, though generally the minimum headway demanded by the timetables is so much greater that a certain unevenness in the signal spacing does not matter. It is, however, a characteristic feature of the full peace-time Anglo-Scottish express services to have groups of trains running at close intervals, and while, in the case of the West Coast route, for example, a five minute headway can be satisfactorily kept over the moderate gradients between Euston and Carnforth the severe banks in the Westmorland fell country and in the Scottish Lowlands usually affect the speed to such an extent that a close headway cannot be maintained. North of Carlisle the 14-mile stretch between Lockerbie and Beattock is covered at a general average of 65 to 70 m.p.h., and then follows the 10-mile ascent at 1 in 70 to Beattock summit where, with a 15-coach train, speed may fall to 25 m.p.h., or less. On the fast running stretches block sections 2½ to 3 miles long will be covered in 2½ to 2¾ mins., but on the upper reaches of the Beattock Bank a section 2 miles long will occupy 5 mins. or more; here, in the worst place possible from the locomotive point of view, the second portion of a heavy express is most likely to suffer delay.

Additional block posts would appear necessary, but only on the track in the ascending direction, since the normal length sections would be covered faster than usual on the descending gradient. Fig. 23 shows how these intermediate signals have been provided. The line on the ascending grade is track circuited for a distance equal to about half that to the box ahead, and an intermediate stop signal IX is installed. Although from the traffic point of view IX constitutes a block post, and as such is preceded by a distant signal, DX, it is actually controlled by the box in rear, A. It corresponds to an advanced starting signal, where Y is the ordinary starter. Assume that an express in two portions is being dealt with. The first portion gets a clear road and passes at its normal speed of 30 m.p.h.; the second portion is following 5 mins. later, so that without intermediate signals the first part would not be clear of the box ahead by the time the second part arrived. But with the layout shown, so long as the first train has passed the intermediate signal IX, and cleared the track circuit, the man at A can allow the second train to go forward up to the intermediate signal; the latter can be cleared only when the train is accepted by the box ahead. In the case under consideration the second train would be passed through without any delay, and the normal 5-minute headway would be maintained. The intermediate signals are almost invariably colour-lights, even though the equipment at adjacent boxes is mechanical, using semaphore arms.

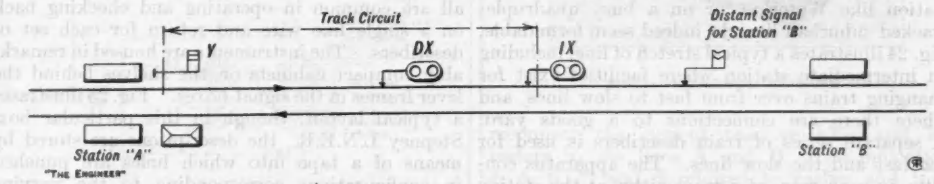



FIG. 23—LAYOUT OF INTERMEDIATE SIGNALS ON ONE ROAD ONLY

Mention of the communication between signal-boxes leads on to the important branch of modern signalling control known as train description. It is quite separate from the signalling system presented to the driver; it provides a set of signals for the signalman, and in certain special cases for the travelling public. The man in charge of a box controlling a main line junction must be given some indication of the route to be taken by the trains he is offered by the box in rear. At the majority of mechanical signal-boxes the flow of traffic is so well defined that signalmen know by the time of day what particular train is coming; if uncertainty should arise, through late running or any other cause, a moment's conversation on the telephone is enough to clear up any doubts. In a busy power box it is different; a signalman's time is well occupied, and when working to an illuminated diagram, without any inter-box bell signalling to announce the class of train, some special apparatus is required to ensure that trains are correctly dealt with. Recourse to the telephone should be reserved for emergencies only.

Like many another well-established feature of modern signalling practice train description had its first extended application on the London Underground railways. On the former District Railway, along the south side of the Inner Circle, the signalling was from an early date entirely automatic between Mansion House and South Kensington stations. Near the latter the line forks, and the signalman controlling the junction would require to know the destination of each train so that it could be routed correctly. While providing apparatus to do this opportunity was taken to instal indicators on the platforms so that passengers could be informed of the destinations of trains approaching. These describers work on what is known as the magazine principle. For the westbound line there is a transmitter at Mansion House, and as each train departs the signalman turns the pointer of his transmitter to the appropriate description and plunges the handle; this action causes a momentary flowing of current in a group of line wires. Different combinations of these wires are energised corresponding to the different train descriptions, so that, for example, by varying the combinations on 4 line wires a maximum of 16 different descriptions can be obtained.

At each intermediate station the current sent out by the transmitter is decoded on an instrument called a combinator, but while the first train to leave Mansion House can be immediately announced on the platform indicators on all the stations ahead, and in the signal-box at South Kensington junction, many more trains will have left Mansion House before the first one reaches the junction. Also, it is not possible to display more than three on each of the intermediate station indicators. Hence, the descriptions transmitted

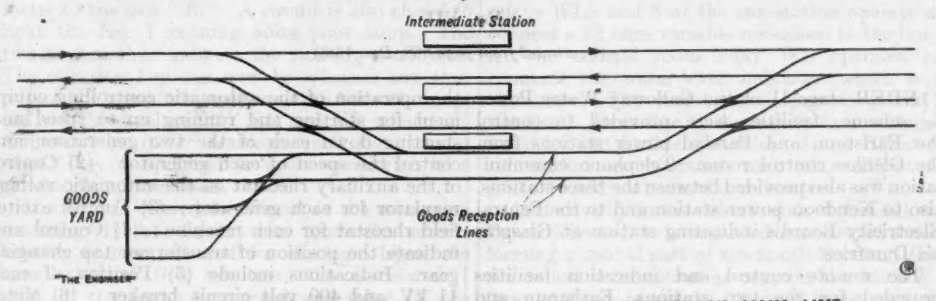



FIG. 24—LAYOUT ILLUSTRATING TRAIN DESCRIPTION ON FOUR-TRACK MAIN LINE

from Mansion House must be stored up until such time as the earlier trains pass and the destinations of succeeding ones can be displayed. This storage of descriptions is done on a receiver, which consists of a drum having a large number of studs on its periphery. Each time a description is transmitted certain studs are depressed and latched and the drum rotates a step. Transmission continues until there are, may be, twenty or more descriptions stored, while through electric contacts on the drum the destinations of the first, second, and third trains approaching are displayed on the platform indicators. The passage of the first train, duly registered by track circuit, causes the unlatching of the first set of depressed plungers; the description is cleared, and the contact fingers move on one step, so that the second train now becomes the first, and so on. This system has rendered excellent service for over 30 years.

When it became necessary to apply train description to the working at large main line terminal stations, such as London Bridge, and Waterloo, Southern Railway, the added complications led to the development of an entirely different system, based largely on the principles of automatic telephone switching. The tasks to be performed by the train description apparatus at a station like Waterloo, or on a busy quadruple-tracked suburban line, do indeed seem formidable. Fig. 24 illustrates a typical stretch of line, including an intermediate station where facilities exist for changing trains over from fast to slow lines, and where there are connections to a goods yard. A separate series of train describers is used for the fast and the slow lines. The apparatus consists, in each case, of a transmitter at the station at the entrance to the particular stretch, re-transmitters—a receiver and transmitter combined—at each intermediate point, and a receiver at the last station. Except for the initial setting up of the descriptions by the signalman at the entering end the whole system is automatic, re-transmission at intermediate points being done automatically by the passage of trains over the track circuits. If, at one such intermediate point, a train is crossed over from fast to slow lines its description is duly transferred from one set of describers to the other. Furthermore, it is possible for the signalman at an intermediate point to interpose a train, such, for example, as a local goods that has been shunting in the sidings clear of the main running lines; all that he has to do is to press one of a series of buttons on the re-transmitter in his box when the train is ready to leave, and its actual departure, through the working of the track circuits, transmits its description forward.

There is, however, one important difference between the ordinary commercial telephone system and this latest form of train description. A wrong number, however annoying to an individual subscriber, is not a very serious affair, but a wrong train description would mean incorrect routing, and consequent delay. It is, therefore, necessary in railway working to have a system of checking to ensure that the re-transmitters and the receivers have correctly responded to the descriptions originally sent out. A great variety of circuits is employed for this checking-back process, but all are common in operating and checking back on a single line wire and return for each set of describers. The instruments are housed in remarkably compact cabinets on the shelves behind the lever frames in the signal-boxes. Fig. 25 illustrates a typical layout, though in this particular box, Stepney L.N.E.R., the descriptions are stored by means of a tape into which holes are punched in configurations corresponding to the varying classes. This is a form of storage that has lately been introduced on the railways of the L.P.T.B., although the actual signal-box layout shown might apply equally well to the telephone type of describers.

*(To be continued)*

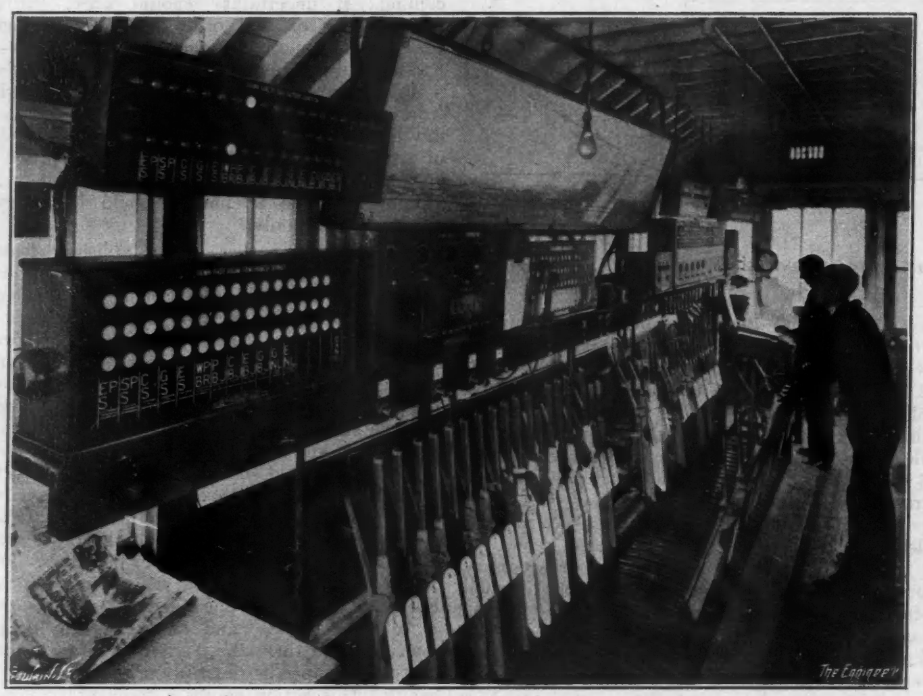


FIG. 25—TRAIN DESCRIBING APPARATUS, STEPNEY EAST SIGNAL BOX, L.N.E.R.

# Remote Supervisory Control

No. VII

*(Continued from page 588, Dec. 15th)*

UNDER stage II of the Galloway Water Power scheme, facilities were provided to control the Earlstoun and Carsfad power stations from the Glenlee control room. Telephone communication was also provided between the three stations, also to Kendoon power station and to the Central Electricity Board's indicating station at Glasgow *via* Dumfries.

The remote control and indication facilities provided for the two stations, Earlstoun and Carsfad, are as follows:—(1) Control and indicate the operation of the automatic controlling equipment for starting and running up to speed and shutting down each of the two generators, and control the speed of each generator; (2) Control of the auxiliary rheostat on the automatic voltage regulator for each generator; (3) Control exciter field rheostat for each machine; (4) Control and indicate the position of transformer tap changing gear. Indications include (5) Position of each 11 kV and 400 volt circuit breaker; (6) Meter readings of the volts, machine amperes, reactive volt amperes, and kilowatt output of each generator, also the voltage of the sub-station battery; (7) Remote and local indication of the water-level in the forebay; (8) Visible and audible alarms are given in the event of the blowing of any supervisory fuse, including sub-station battery, control room battery, or line fuse; (9) abnormal temperature rise of generators and outlet air; (10) failure of oil pump; and (11) change of position of intake gates associated with turbines.

The pilot wires are in lead covered cable carried on the same poles as the power lines. Four pairs are utilised for each station, one pair for supervisory control and transmission and three pairs for metering. Telephone communication is provided by means of a phantom circuit on two lines which are normally used for metering.

Separate control boards are, as already stated, provided at Glenlee for the two stations, the lay-out of the equipment being identical, except for the designation labels for the inter-connector panels. The control keys and associated lamps are grouped together in the centre of the desk portion of the board, the lamps being arranged to illuminate a stencil adjacent to their associated control keys. Circuit arrangements are such that only the stencil associated with the selection made is illuminated. As shown in the rear view, Fig. 46 in the previous article, the line protection equipment and the supervisory remote control equipment are mounted inside the control boards. The apparatus is assembled as self-contained units as standard jack-in type relay bases.

In Fig. 50 is shown in schematic form, and in accordance with telephone engineering practice, the circuit arrangements in association with four pairs of pilot wires. In the majority of cases only the relay contacts are shown. Selection of any apparatus for control purposes is carried out by means of the fixed number of impulse system as previously described for Tongland, but in this case the impulse train consists of 50 impulses. Referring to line D it will be seen that relay PT, on the left near the centre of the diagram, controls the reversing of the line current *via* KR contacts and the centre tap of the battery.

A selection key is associated with each piece of apparatus and an interposing relay is required for each control operation. Two, for example, are needed for each circuit breaker, one for the "close" operation, and one for "trip." Two interposing relays are also required for each generator, one for "start up" and one for "close down." Two such relays are required per generator for "raise" and "lower" speed, &c.

Assuming it is required to trip the circuit breaker of the auxiliary transformer, the associated selection key would be thrown on to the "trip" position. The impulse train sent to the line would then cause the appropriate uniselector in the B group, shown in the lower right-hand corner of the diagram, to be stepped to the set of contacts on which the corresponding interposing relay is wired.

When the selection is completed, relay KR at the control room releases and relay H at the sub-station operates to send a holding pulse back to the control room. The direction of this pulse is determined by relay RVS at the sub-station which is operated if the particular circuit breaker is in the closed position and normal if the breaker is tripped. Relay IP at the control room and relay SP at the sub-station operate over the loop. Relay IP operates relay SH which closes the circuit for the stencil lamp shown in lower part of the diagram on the left, *via* wiper and bank contact of a uniselector (see banks S3 and S6) which will have stepped to the correct position. Stencil lamps are indicated by a cross within a circle. Relay SP at the sub-station maintains relay H. The operator can now depress the trip key to operate relays OPB, PT, and BK, in the centre of the diagram. Relays OPB and BK disconnect relays IP and remove current from the line. Relays SP and H at the sub-station release. Relays R and PB now operate to complete the circuit of the trip interposing relay. The circuit breaker then trips and its auxiliary contacts change over and release relay RVS near the middle part of the diagram. Relay H now re-operates and a holding pulse is then transmitted to the control room in the reverse direction. This operates relay OP which causes a magnetic locking relay associated with the particular breaker to release and so change the indication lamp from red to green, thus indicating that the breaker has been tripped. Should the "close" key be depressed, a similar circuit operation takes place, but in this case relay PT does not operate, so that

the current to the line operates relays N and PB at the sub-station. Relays N and PB (see lower right-hand corner of diagram) close the circuit for the "close" interposing relay. When the auxiliary contacts of the circuit breaker change over relay RVS re-operates and sends back the "closed" indication. Circuit operations for the generator "start up" and "shut down," also for the 400 volt circuit breakers, are performed in a similar manner.

As regards transformer control when the desired selection is completed, the transformer control stencil is illuminated and operation of the raise or lower key causes the respective interposing relay at the sub-station to be operated. This in turn closes the local circuit for raising or lowering the taps on the transformer. The tap change indicator consists of a uniselector mechanism having a pointer attached to the shaft. The driving circuit is controlled by four magnetic locking relays, the operation or release of these being controlled by this case causes either relay SR or SL at the sub-station to operate, *via* the other wire of line "C" and one wire of line "D," to effect the desired speed control.

From the upper part of Fig. 50 it will be seen that the current, reactive kVA and kW meters for the generators are normally reading over lines "A" and "B." The running voltage is given over line "C" *via* the operated contacts of relay VCO when generator No. 1 is running and *via* the normal contacts of relay VCO when No. 2 generator is at work. An indication of the running voltage can be selected from any feeder or generator connected to the bus bars.

Assuming the running voltage from No. 1 generator is selected, then at the end of the selection, relays RV and RI (contacts are only shown) at the sub-station operate. Relay RV contacts disconnect the current transformer and switch line "B" on to the potential transformer

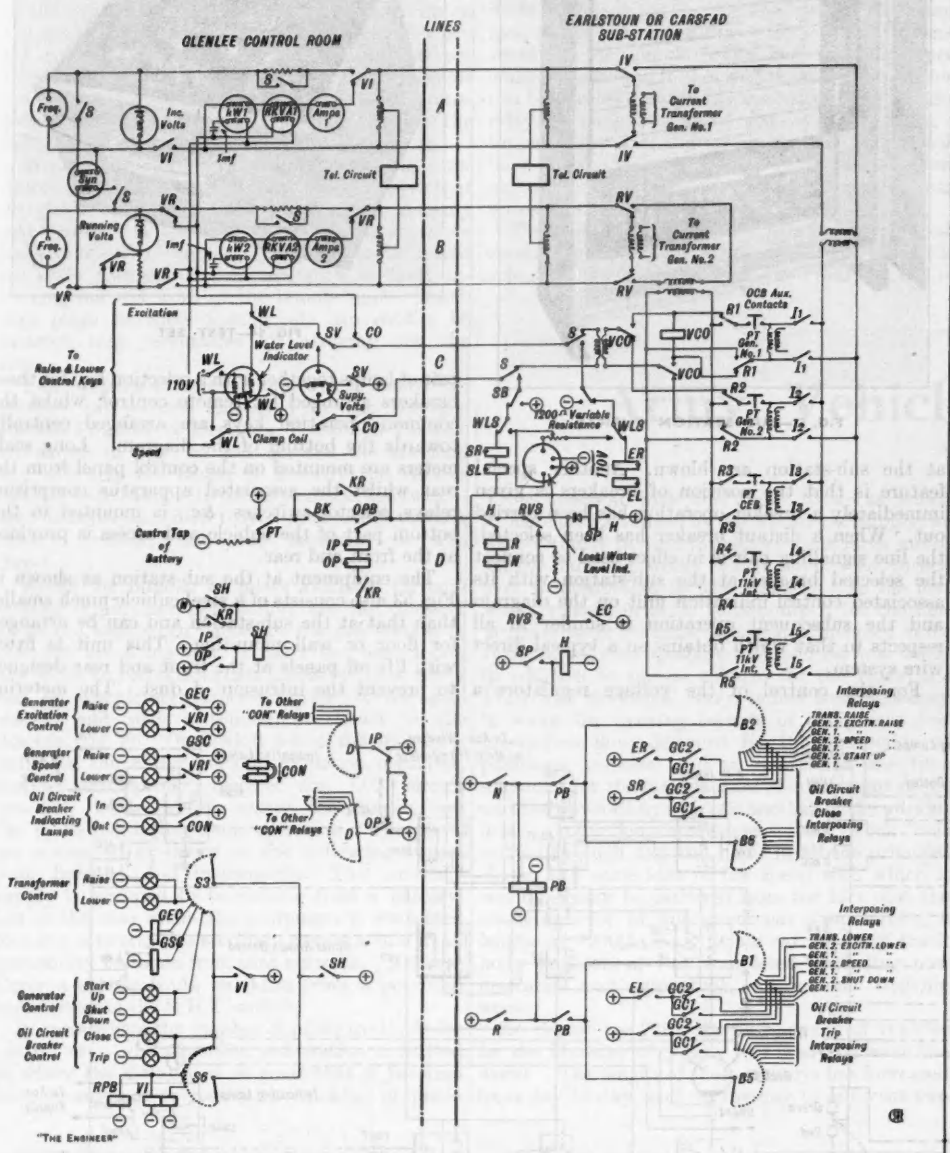



FIG. 50—SCHEMATIC CIRCUIT ARRANGEMENTS

potential transformer of the selected feeder to line A. At the control room relay VI operates to disconnect the current reactive kVA and kW meters of generator No. 1 from the line and connect the incoming voltmeter and frequency meters.

The circuit for the control of both the speed and excitation of the generator is also completed *via* operated contacts CO at the control room, line "C," operated contacts S at the sub-station, and one wire of line D. The circuit conditions are now such that the voltmeter and frequency meter on line A indicate the incoming feeder conditions on to which the generator is required to be synchronised, whilst the frequency and voltage of the generator are indicated over line B. When the frequency and voltage indicated on the two pairs of meters are approximately alike, the synchroscope key is actuated to introduce the synchroscope. Relay S at the sub-station then operates and prepares a circuit for the close control key. Contacts on relay S also complete the synchroscope circuit. Upon synchronism and equality of the incoming and running voltages being reached, by suitably adjusting the speed and excitation of the generator, the feeder circuit breaker can be closed by the operation of the "close" control key. The synchronising process being thus completed, the feeder circuit breaker selecting key can be restored, whereupon all the remote control equipment returns to normal. Relays RV, IV and VI and VR are thus restored to

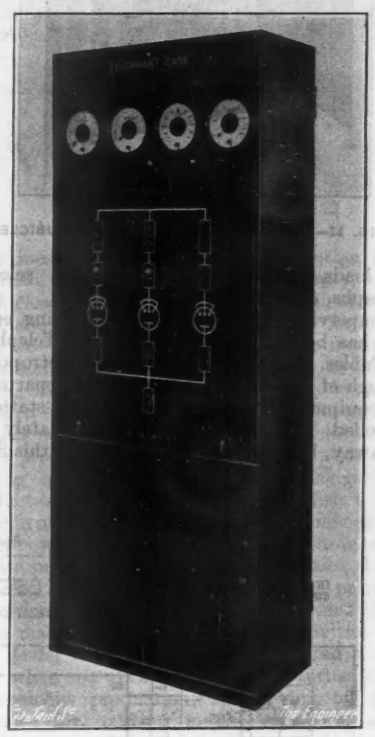


FIG. 51—CONTROL CUBICLE

coded pulses from the sub-station. The mechanism can be stepped to any one of 15 positions, the actual positions being determined by various combinations of the relay contacts.

Turning now to generator excitation control, at the end of selection, relay S at the sub-station operates and relays CO, SH, and GEC at the control room operate and the stencil "generator excitation control" is illuminated. The excitation "raise" and "lower" keys are thus switched into circuit over one wire of the "C" line *via* the operated contacts of relay CO. The operation of these keys causes either relay ER or EL at the sub-station to operate *via* one wire of line "D" and operated contacts SH to the centre tap of the battery. The particular interposing relay is thus in turn operated to complete the desired local control of the field excitation.

The circuit arrangement for generator speed control is similar to that for generator excitation control, except that relay GSC operates instead of relay GEC (see lower left hand of diagram) and closes the circuit for a separate pair of control keys and stencil lamps. Operation of the key in *via* the operated contacts of relay RI and the closed auxiliary contacts of the circuit breaker. Relay GCI (contacts only shown) at the sub-station also operates to prepare the control circuits for No. 1 generator speed and excitation. At the control room relay VR operates to disconnect the current, reactive kVA and kW meters of the generator No. 2 and connects the running voltage meter and also the running frequency meter to the line "B." A circuit is also closed to light the No. 1 running volts pilot lamp. The two meters thus indicate the running conditions. The selection key can now be released and thus release the signalling equipment to normal except the switching relays RV, RI, and VR which will maintain the meter readings until the "meter reset" key is operated or upon completion of a synchronising operation.

If now it is desired to connect to the station an incoming 11 kV feeder, the particular circuit breaker is next selected for closing. Upon the completion of this selection, the associated I relay of the feeder connected and relay IV are operated at the sub-station and connect the reconnect the current reactive kVA and kW meters to the lines A and B. The indications 4, 5, 6, 7, and 8 referred to earlier and those associated with generator control such as "generator started," "run up to speed" and "shut down" are transmitted to the control room in a similar manner to that described for circuit breakers. At the sub-station, either the operation on the auxiliary contacts on the device to be indicated, or the operation of an associated pilot relay causes a pulse to be sent back to the control room to release a magnetic locking relay allocated to the particular indication. These relays cause the associated lamps to glow and in the case of 5, 6, and 8 an audible alarm is given.

At the completion of the water level selection relays WLS and S at the sub-station operate and connect a 12 ohm variable resistance to the line C. At the control room relay WL operates and connects the water-level indicator which is an ohmmeter. The variable resistance is geared to the gate. Over line C the sub-station voltage is indicated but in this case relays S and SB at the sub-station are operated, and relay SV at the control room connects the voltmeter.

As the five hydro-electric stations of the Galloway Power Scheme may be regarded as a selected scheme forming a special part of the South Scotland Grid, the fullest information as regards the loading of these stations is always required to be available to the Central Electricity Board's officials at the

central indicating station in Glasgow. Accordingly the supervisory and indicating apparatus installed for the Central Electricity Board is very comprehensive and includes both-way selective telephones to all five stations, indications of oil circuit breakers and transformer tap changing gear positions, photo-telemetering of station, total and inter-

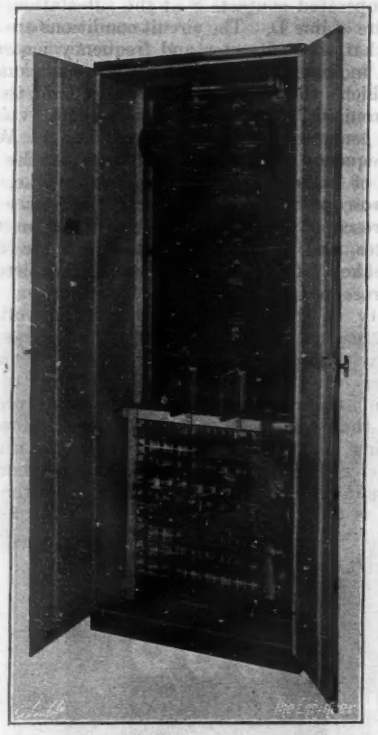


FIG. 52—REAR VIEW OF CONTROL CUBICLE

area loads and reactive components, selective telegraphs, &c.

A supervisory control and telemetering equipment has been installed by Standard Telephones and Cables, Ltd., on the system of the Metropolitan Borough of Bermondsey's Electricity Department. The equipment at Elephant Lane sub-station is controlled from Neckinger, approximately one mile away, by supervisory apparatus of this firm's latest design. Facilities here provided normally require four wires between the control station and the sub-station, but as in the present case only three wires were available the equipment, of which unfortunately we have no full detailed technical particulars, was modified accordingly.

The facilities include control and indication of three Hewittic rectifier oil switches, indication of the position of four D.C. breakers, the control of three motor operated voltage regulators, the selection of seven meter readings comprising D.C. volts, rectifier load in amperes, and D.C. out of balance current in amperes. Telephony is provided between the control station and sub-station. Besides the usual ancillary facilities such as means of checking the control diagram automatically and giving an alarm in the case of blown fuses there are other features. Should a pilot line break or be short circuited, the line proving current is interrupted and results in an audible and visible signal being given immediately at the control station. A separate alarm is also given if fuses

FIG. 53—SUB-STATION CUBICLE

at the sub-station are blown. Another special feature is that the position of breakers is given immediately a breaker operation has been carried out. When a distant breaker has been selected, the line signalling pair is in effect used to connect the selected breaker at the sub-station with its associated control indication unit on the diagram and the subsequent operation is similar in all respects to that which obtains on a typical direct wire system.

For the control of the voltage regulators a similar direct connection is established on selection. In this case the position indication or supervision is given on the appropriate voltmeter which has been selected previous to the initiation regulator control itself and remains directly connected as long as may be required. The necessary adjustment of the regulator is then completed by means of "raise" and "lower" buttons common to the whole equipment.

The equipment comprises two main units, one at the control station, Figs. 51 and 52, and one at the sub-station, together with miscellaneous metering units. As shown in the illustrations the control station unit is in the form of a steel cubicle, the front of which carries the control panel complete with mimic diagrams, control and indication units, meters, selection keys, &c.

Each breaker is represented in the diagram by a pair of lamps together with a selection key for these breakers arranged for remote control, whilst the common operation keys are arranged centrally towards the bottom of the diagram. Long scale meters are mounted on the control panel from the rear whilst the associated apparatus comprising relays, selector switches, &c., is mounted in the bottom part of the cubicle and access is provided at the front and rear.

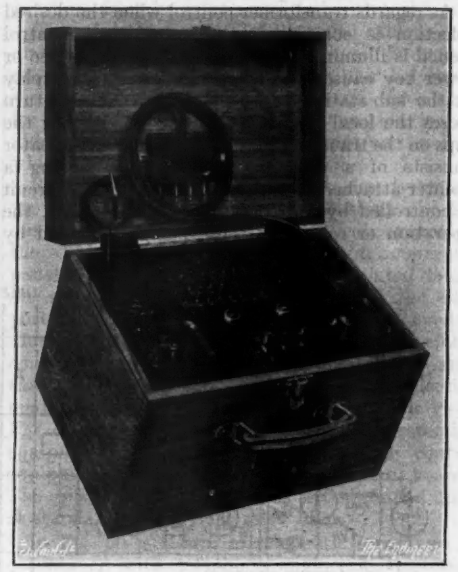
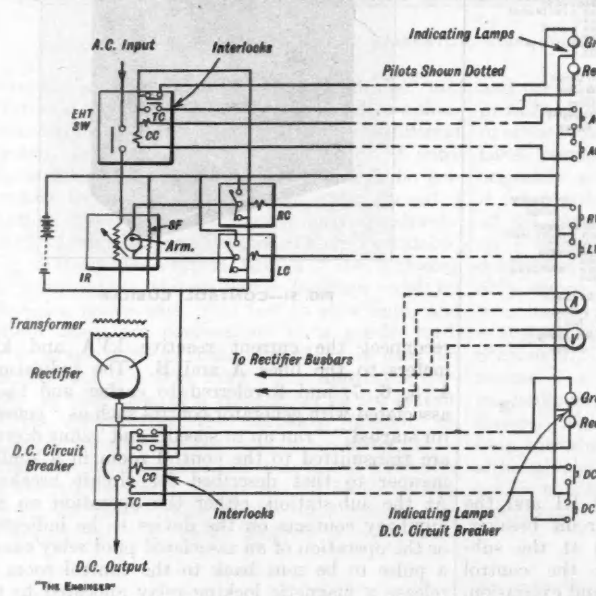


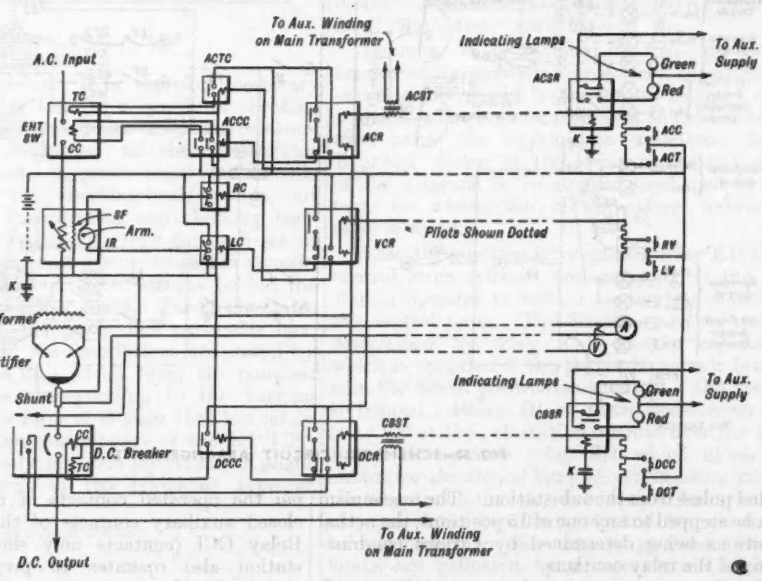
FIG. 54—TEST SET

The equipment at the sub-station as shown in Fig. 53 also consists of a steel cubicle much smaller than that at the sub-station and can be arranged for floor or wall mounting. This unit is fitted with lift off panels at the front and rear designed to prevent the intrusion of dust. The metering units, comprising the out of balance shunts and the potentiometer for the pressure circuits, together with the necessary switching contactors, are supplied separately for inclusion in the power circuits. The general principles of operation are as follows :—Controls and indications are transmitted between the two stations in either direction over one pair of wires by means of codes or trains of impulses. Receiving equipment connected across the line at each location responds to these impulses




A.C.C.—A.C. Close Push Button.
A.C.T.—A.C. Trip Push Button.
R.V.—Raise Volts Push Button.
L.V.—Lower Volts Push Button.
D.C.C.—D.C. Close Push Button.
D.C.T.—D.C. Trip Push Button.
A.C.R.—A.C. Control Relay.
V.C.R.—Voltage Control Relay.
D.C.R.—D.C. Control Relay.
A.C.T.C.—A.C. Tripping Contactor.
A.C.C.C.—A.C. Closing Contactor.
R.C.—Raise Volts Contactor.
L.C.—Lower Volts Contactor.
D.C.C.C.—D.C. Closing Contactor.
T.C.—Trip Coil.
C.C.—Closing Coil.
I.R.—Induction Regulator.
A.C.S.R.—A.C. Signal Relay.

FIG. 55—DIRECT CONTROL




C.B.S.R.—Circuit Breaker Signal Relay.
A.C.S.T.—A.C. Signal Transformer.
C.B.S.T.—Circuit Breaker Signal Transformer.
S.F.—Shunt field of Driving Motor of Induction Regulator.
Arm—Armature of Driving Motor of Induction Regulator.
K—Condenser.

FIG. 56—RELAY CONTROL

and when the signal received is correct connects the appropriate link circuit.

Meter readings of amperes and volts are provided. In the case of the former, the appropriate secondary current transformer or D.C. shunt is selected and connected to the metering pilots at the sub-station, whilst at the same time the appropriate ammeter is introduced at the control station. For readings of volts the 250 and 500 volt circuits potentiometer is introduced at the sub-station, when selection takes place, and the indication of the tapping is registered on the appropriate volt-meter on the control diagram. The load on the rectifiers is derived from the A.C. side, the meter on the diagram being calibrated in D.C. amperes. When selected, the meter reading can remain established, as long as may be desired, whilst permitting ordinary signalling as may be required for control and indication.

Small capacity 50 volt batteries complete with trickle charging units are used for the operation of the equipment at each position. The drain on the batteries is practically negligible except when the control operations or signal indications are taking place. The lamps on the control diagrams are normally supplied from a step down transformer but can be transferred to the battery in the case of A.C. mains failure.

While in the ordinary way the equipment requires practically no attention, it is desirable that any fault which may occur can be rectified easily and readily. A testing set, Fig. 54, has therefore been provided to enable either unit to be tested for code transmission or reception without involving manual work at the remote unit. Multi-way plugs on these testing sets can readily be inserted into receptacles for carrying out the test.

Two systems of remote supervisory control of rectifier sub-stations employed by the Hewittic Electric Co., Ltd., of Hersham, Walton-on-Thames, are shown in Figs. 55 and 56, and the attached key will help the reader to identify the various items in both cases. In the former case, the switch-gear is controlled direct over pilot wires to each circuit breaker, and the metering is also direct.

Where the number of pilots available for controlling a rectifier sub-station are not limited, as in the case when cables to the sub-station in question are being run, it has often been found advisable to instal adequate pilots, so that relays can be completely dispensed with at the sub-station and such a scheme is shown in the diagrrm Fig. 55. On the left side of the drawing is indicated the E.H.T. switch, induction regulator, rectifier transformer, rectifier and D.C. circuit breaker; while running across the drawing are the pilots controlling their operation. The pilots are connected as shown to the indicating lamps, push buttons, and instruments. The auxiliary supply is assumed to be coming from a battery, but in the case where the equipment is connected to a live network, this auxiliary supply would in all probability be taken from that network. Alternatively a supply could be taken from a potential transformer in the E.H.T. switch.

In cases where the number of pilots available for control of a given rectifier sub-station is limited or where the distance is so great that it becomes more economical to reduce the number of pilots and fit selective relays at the sub-station end, a similar arrangement to that outlined in Fig. 56 is employed. In this arrangement, on pilot serves for closing and tripping the E.H.T. switch, operating through a selective relay A.C.R.

Further pilots are required, one for raising and lowering volts, one for closing and tripping the D.C. circuit breaker, one to act as common feed, and three for the ammeter and volt meter. The relays A.C.R., V.C.R., and D.C.R. are double element type, each element comprising a coil and its associated contacts. The two coils in each relay are connected in series. The operation of these relays are as follows. One element is arranged to operate at a current half the value at which the other element operates. The light current element is interlocked through a normally closed contact of the heavy current element, therefore, when the light current element operates, current flows *via* the normally closed contact on the heavy current element, whereas when the heavy current flows, although both elements operate the interlocking contact of the heavy element relay opens, breaking the circuit while the normally open contact closes and in this way the double operation can be effected by varying the current through the relay. This is done at the remote end by using a tapped resistance, and arranging so that one push button operates with the full resistance in series, and the other push button with half the resistance in series.

These selective relays can handle only a small current, and auxiliary relays are used to effect the actual operation of the closing coil and trip coil of the E.H.T. switch, and the operation of the induction regulator and the closing coil of the D.C. circuit breaker. These auxiliary relays are connected as shown in the diagram.

Indication at the remote end is effected in the following manner. A signal transformer in the pilot controlling the E.H.T. switch is connected on the secondary side to an auxiliary winding on the rectifier transformer. When the transformer becomes alive the signal transformer is energised, and a circulating A.C. current passes down the pilot through the pilot relay to earth, and so back to the signal transformer. This causes the contacts of the signal relay to change over, and the green light which indicated that the equipment was dead goes out, and the red light comes on. In a similar manner another signal transformer C.B.S.T. is connected in the pilot operating the circuit breaker. In this case, however, the signal transformer is supplied from the auxiliary winding on the main transformer through a normally open interlock on the D.C. circuit breaker and the closing of the D.C. circuit breaker finally causes the current to circulate through the signal relay at the remote end, and the relay operates in the same way as previously described.

The ammeter is shown having a centre-tapped resistance, connected across it at the remote end, the ammeter shunt being connected at the sub-station end in the positive from the rectifier. In this way, the volt-meter at the remote end can be connected to the mid point of this resistance, and only one lead taken back and connected to the negative thus saving one pilot.

# Army Vehicle Manufacture

## No. I

IN connection with the visits to works which have been arranged by the Ministry of Supply, we were recently invited to inspect some large motor vehicle building works which have been turned over to production for the Ministry. In the first works visited, in order to re-equip it for the new programme of manufacture, which included three types of vehicles specially designed for war work, in addition to special vehicles for the Royal Air Force and the Royal Navy, it had been necessary to scrap the existing layouts of equipment and production flow, designed for the production of passenger vehicles, and to re-organise the time schedules for the manufacture of component parts, and the dovetailing into one another of the various mass production operations. This work was carried through day and night in all the principal shops, and some idea of the speed with which it was done may be gathered from the fact that the changing over of one particular shop having a length of 1200ft. from motor car to army truck body production, was completed, including new machines and equipment, within one working week.

By September 23rd, the first convoy of vehicles for the Ministry of Supply was ready to leave the works. The length of these convoys has increased from day to day, and on the day of our visit two long lines of completed vehicles on either side of the road, were waiting to be driven away. Every week close upon a million pounds worth of vehicles are made, assembled and tested, ready for handing over to the Ministry. The output, it may be remarked, is over one hundred times as great as during the last war when the same works was engaged on the production of the "war car." As regards cost of production, four vehicles are now being produced at what was then the price of one. During our visit we noted that alongside the production of wartime vehicles, the firm's export trade in motor cars and lorries is not being neglected. Even now, 60 per cent. of the export trade is being maintained in spite of shipping difficulties, shortage of petrol in several countries, and the priority of Government work. In other ways, every effort is being made to keep normal trade activities going. The dealer organisation, which suffered a severe blow when the works was suddenly turned over to Government production, is carrying on service facilities for existing motor transport, and is being encouraged to develop similar service facilities and educational services for Army and R.A.F. transport. A visitor to the works could not fail to be impressed with the excellent welfare facilities, and the care and the cost of well-planned Air Raid Precautions and works camouflage.

ENGINE ASSEMBLY ON A A CONVEYOR

ARMY TRUCKS ON FINAL ASSEMBLY CONVEYOR

Alongside the actual manufacture of the various vehicles, special services for the instruction of the various units to which the vehicles are delivered, have been put into operation, and include the supply of drawings and enlarged photographs, for instruction purposes, driving handbooks, and sectioned chassis and components for teaching the repair and servicing of the vehicles. Special staff liaison engineers have been appointed to ensure complete co-operation between the factory and the War Department transport units, operating the vehicles. Entering the works at the receiving stores, we saw the many hundreds of tons of war materials, such as castings, forgings, sheets, and bars which are received, sorted, inspected, and drying they receive a number of parts such as the dashboard instruments and wiring connections, before being lowered through an aperture in the floor to a final assembly belt below. The accurate linking up of the various finished parts such as chassis, cab, and body work was carefully timed, and effectively carried out. Another department which we found of particular interest was that in which two of the three different types of vehicles now being produced under Government contract, were being made. The various parts of the body, such as the bearers and runners, the floor, back, front, and sides were seen in course of construction in jigs, on completion of which they were assembled into a complete body, and then swung on to a from rolls of foil, and are then placed in frames and passed through an automatic soldering machine. The machine in question has a length of about 70ft., and in passing through it on a moving belt, the core members are preheated, coated with flux, and then soldered by dipping in a bath of molten solder. The machine is automatically fed with solder, and its action is such that the core frame is turned over after one side has been soldered after which the completed core passes to the section of the department in which the top and bottom tanks are added, and the radiator then tested for water flow. Other departments to which a brief visit was paid included the assembly shop for back axles, and the

ENGINE TESTING AND RUNNING-IN DEPARTMENT

tested every day, and pass direct to the engine machine shop.

The engine machine shop and assembly of the engine are organised on a line production basis. There are long lines of machine tools which are arranged for the machining and finishing of individual components, from the raw materials supplied. These we noted included such parts as camshafts, connecting rods, pistons, cylinder-heads, cylinder blocks, flywheels, and manifold housings. The finished parts are inspected and tested, and then pass to the unit assembly conveyors which run along one side of the machine shop.

These parts then pass to the engine assembly shop, in which a number of machining operations are carried out. Parts such as connecting rods, gudgeon pins, and pistons are graded and assembled on long lines of unit assemblies, all of which are linked up with the final engine assembly conveyor, which runs along one side of the building. As it passes along the conveyor, the engine of the vehicle is built up in connected stages, starting with the cylinder block and sump, and proceeding part by part to the completed engine, which again is transported by a conveyor to the engine testing shop, a view of which we show on this page. No less interesting was the department devoted to cab building painting and trimming. We saw the steel cab being built up in special jigs, arranged for the spot, flash, or seam welding, of the various parts, which after completion pass to the paint and trimming shop. The cab assemblies move on conveyor belts, through the sanding and smoothing process, after which they receive the priming and finishing coats of paint by spraying. After conveyor, carrying them through the paint spraying booths and drying ovens. On reaching the end of a long conveyor line the finished body is lowered through an aperture in the floor on to the final assembly conveyor which runs below. Another continuous production line we inspected was for the building up of the bodies of other Government contract vehicles. It has a length of over a third of a mile, and follows a system generally similar to that already described. The body is assembled on the upper floor, drawing the various sub-assemblies from bays situated at intervals along the conveyor line. On completion it is lowered on to the waiting chassis on the conveyor line on the ground floor of the factory. The series of operations begins with the bare chassis frame, and to the frame are added the front and rear axles, which are assembled in side bays and pass to the main conveyor at appropriate distances along its length. While upside down, the chassis frame receives its axles and springs, and after being thoroughly greased is turned over to complete its one-third of a mile journey along the line. Each man has a job or jobs to do in an allotted time, and without apparent haste, the chassis takes on its finished form, the engine being lowered into position, and the braking and steering equipment fitted. The body is then added, and the wheels put on to the axles, after which the petrol and water tanks are filled, and the vehicle inspected before undergoing the scheduled tests.

An unusually interesting department of the works was that set apart for the making of radiators. The core of the radiator is built up from a number of crimped copper strips, which are machine cut press shop. Throughout our tour of the works we noted the high proportion of inspection staff to the productive staff, and the large number of scientific testing instruments, showing that quantity production has meant no lowering of the high standard of machining and finish, inseparable from high-class motor manufacture.

*(To be continued)*

## BRITISH STANDARDS INSTITUTION

*All British Standard Specifications can be obtained from the Publications Department of the Institution at 28, Victoria Street, London, S.W.1. The price of each specification is 2s. 2d. post free, unless otherwise stated.*

### ROAD TRAFFIC SIGNS AND POSTS

(B.S. No. 873).—With the multiplicity of Government Regulations affecting road traffic signs, the Association of Road Traffic Sign Makers asked that a standard should be prepared to cover the construction of the many signs that form the subject of Regulations and Notices issued by the Ministry of Transport. This new specification deals with the material, quality, and finish of cast metal signs, the material, quality, dimensions, and finish of the posts, and general requirements for the fittings for connecting the sign to the post. The optical properties of reflectors and reflecting media are not included in the present issue but they are being investigated and it is intended to issue requirements for them later as an addendum to the specification. In the meantime certain general conditions with which reflectors and reflecting media shall comply are given pending their more complete specification.

## Rail and Road

GERMAN RAILWAY ACCIDENTS.—The seventh railway accident in Germany since the outbreak of war occurred on the night of Tuesday, December 12th, when two trains collided on the line between Hagen and Wetter. Reports state that 17 persons were killed and 41 injured.

RAILWAY ACCIDENT AT BILLINGHAM.—On the morning of Thursday, December 14, an express train from London ran head on into a goods train standing on a side line at Billingham Tees. The goods engine was thrown over on to its side, and several carriages were damaged. No passengers were hurt, and the train crews escaped with minor injuries.

THE TRANS-CANADIAN HIGHWAY.—Reports state that the Province of Ontario is to begin the construction of the final 112 miles of road which will complete the trans-Canadian Highway between the Atlantic and the Pacific. This stretch of road lies between Geraldton and Hearst in the Ling Lac area north of Lake Superior and its cost is estimated at 5 million dols.

MOTOR FUEL IN GERMANY.—According to the Petroleum Press Bureau, the German authorities have ordered the conversion of all petrol engined lorries of over 1½ tons capacity to use propane or butane fuel. The conversion will be carried out at a uniform charge of about £20 per vehicle, but the Bureau points out that on well-informed estimates the German production of liquid gases is sufficient for only about 45,000 vehicles out of the 115,622 in use before the war.

REINFORCED CONCRETE SLEEPERS.—A short article in the *Railway Gazette* describes a reinforced concrete sleeper which has been developed by the State Railways in the Netherland East Indies. In it a length of old flat-bottom rail, placed foot uppermost, forms an anchor between two concrete blocks, and rail bearing plates are welded to it. The running rail is secured to the sleeper by coachscrews screwed into metal-spring lined holes. The blocks are reinforced by a length of heavy wire which is interlaced through holes drilled in the web of the old rail length.

L.M.S. APPOINTMENTS.—The following appointments have been approved by the Directors of the London Midland and Scottish Railway Company; Mr. F. W. Abraham, Assistant Divisional Superintendent of Operation, Manchester, to be Assistant Divisional Superintendent of Operation, Crewe. Mr. P. McCallum, Assistant to Superintendent of Motive Power, Euston, to be Assistant Divisional Superintendent of Operation (Motive Power), Manchester. Mr. E. A. Talbot, Head Office Inspector (Motive Power), Derby, to be Assistant District Locomotive Superintendent, Bristol.

TWO NEW HIGH-SPEED TRAINS IN AMERICA.—Two new streamlined trains have been placed in service by the Chicago and North Western Railroad between Chicago and Minneapolis. They are scheduled to cover the 400 miles run in 6½ hrs. and each train consists of a 4000 H.P. two unit oil-electric locomotive hauling 10 coaches. Each train is 960ft. long and weighs 885 tons including the 308 tons of the locomotive. The two 2000 H.P. units comprising each locomotive may be operated independently if required. According to the *Railway Age*, each locomotive unit has as its prime mover two 1000 H.P., two-stroke, 12-cylinder oil engines coupled to a 600-volt D.C. generator. The trains are designed for a maximum speed of 117 miles an hour.

ROAD CONSTRUCTION PROGRAMMES.—At the annual general meeting of the Institute of Transport, Captain Euan Wallace, the Minister of Transport, said that the curtailment of road construction programmes in this country is expected to account for a saving of between 5 and 10 million pounds during the next financial year. He anticipated that total curtailments would effect a reduction of about 50 million pounds, the saving being spread over several years. The road schemes which had been approved at the beginning of the war had been divided into four classes:—those to be completed; those upon which it was not possible to make an immediate decision; those to be closed down at the earliest practicable stage; and those not essential and not to be considered at present.

AIDS TO NIGHT DRIVERS.—In peace time painted white guide lines in the centre of the carriageway were used, in the form of solid lines, at the immediate approaches to road junctions, on road bends, and over bridges where visibility was restricted. Elsewhere the guide line was broken; there were gaps of 15ft. between the 3ft. long painted markings. Since the lighting restrictions came into force, all Class I roads and other roads having sufficient traffic importance have been provided with painted guide lines. At bends and junctions the while line remains a solid line; on straight lengths of road the gaps between the painted markings have been reduced to 3ft. Warning of the approach to cross roads and road junctions is given in the middle of the traffic lane by a painted cross for cross roads, a T on its right or left side for turns, and a T upright for a tee junction. Where roads carry three lines of traffic drivers are assisted to find the nearside traffic lane by pointers from the white lines towards the nearside kerb.

MEXICAN RAILWAYS.—It is stated in *Engineering News Record* that, despite the economic depression and difficulties in obtaining materials as a result of the European War, the Mexican Federal Government is going ahead with the construction of four trunk railways begun in 1936. A combined length of 960 miles is being built at a cost of about 31 million dols., and efforts are being made to have the work completed by the end of next year. The four principal lines are:—the South Eastern, which will be 450 miles long to connect Mexico City with the isolated areas in the States of Campeche and Yucatan; the 220 miles of line between Ixcaquixtla, in the State of Puebla, and Chacahua Bay on the Pacific; the North West line, 100 miles in length joining Fuentes Brotantes, in the centre of Lower California, and Punta Penasco, a port on the Gulf of California, and a line joining Caltzonzin, Michoacan State, and Central Mexico. A branch line 60 miles long is to be built between Punta Penasco and Sonoyta in Sonora. This work will cost 830,000 dols.

## Miscellanea

REGISTER OF SAFETY OFFICERS.—In order to help those who want work as Safety Officers and firms who have vacant positions for such people, the National Safety First Association is setting up a Register of Safety Officers. Any Safety Officer or other person wishing to have his name put on the Register, should write to the Association at 52, Grosvenor Gardens, London, S.W.1.

VAKHSH IRRIGATION SYSTEM.—The completion is reported of the Vakhsh irrigation system in Tajikistan, Central Asia. The new system of canals, which have an aggregate length of 1056 miles, will irrigate some 230,000 acres of land. The building of the system is stated to have involved the excavation of 476¾ million cubic feet of earth, the laying of 940,000 cubic feet of concrete, and the erection of 2600 different subsidiary structures.

REINFORCED CONCRETE PIT PROPS.—An article in the *Iron and Coal Trades Review* by Dr. W. H. Evans, deals in detail with the construction and properties of reinforced concrete pit props. He points out that the average crushing strength of good quality timber pit props is 4000 lb. per square inch, and this is much the same as that of good concrete. The reinforcement favoured is in the form of a ¼ or ⅜in. rod arranged in a spiral with a pitch of 1 to 1½in. just below the surface of the concrete.

CONTRACTS AND MINISTRY OF SUPPLY.—It has recently come to light that certain persons purporting to have special facilities for approaching the Ministry of Supply have offered their services to contracting firms as intermediaries on a commission basis. The Ministry of Supply wishes to make it clear that if a firm wishes to be considered for Ministry contracts it is free to apply direct to the Ministry, and that all such applications are dealt with on their merits. There should, therefore, be no necessity to employ intermediaries.

FAILURE OF GAS CYLINDERS.—Recent investigation by the Department of Scientific and Industrial Research at the National Physical Laboratory into the cause of failure of certain cylinders for compressed gas, has revealed that small quantities of sulphur impurities in the gas (either in the form of hydrogen sulphide or as organic compounds) or of moisture may cause the cylinder to fail. Although it has not yet been established to what extent steels of different composition may be affected, the effect of these impurities is severe on nickel-chrome-molybdenum steel and may be so with other steels. It is, therefore, of the greatest importance to ensure, especially in the case of coal gas or methane produced from sewage, that the gas is free from hydrogen sulphide, any organic sulphur compounds, and from moisture.

REINFORCING BARS AND RUST.—A report of the Concrete Reinforcing Steel Institute in the United States says that the bond resistance of deformed steel bars that have been exposed to normal rusting conditions is considerably greater than that for non-rusted mill surface bars. A series of tests showed that for all sizes of bars the bond resistance was greatly increased after twelve months' exposure; for ⅜-in. to ¾-in. round bars the resistance after such exposure was increased 100 per cent.; for larger bars the resistance remained approximately constant up to and including nine months, but increased considerably with more exposure; in general, outdoor exposure produced greater bond resistance than indoor exposure; bond resistance for fifteen months' exposure was found to be about the same as for twelve months.

BLAST FURNACE AIR CONDITIONING.—In a paper before the Eastern Air Conditioning Conference at Lehigh University in the United States, Mr. L. Logan Lewis gave particulars of the conditioning of blast furnace air at the plant of the Woodward Iron Company. The blast furnace has an output of 400 to 500 tons per day of merchant pig iron and requires 45,000 to 50,000 cubic feet of air per minute. Water is remove dby cooling and condensing with direct sprays on the suction side of the blowing engines. The plant normally requires 2700 tons of air per day, or 5·6 tons per ton of iron. Mr. Lewis said that on a maximum day the dry air plant prevents more than 30 tons of water from entering the furnace. The lowering of the moisture content in the blast reduces the amount of coke required per ton of iron produced and increases the total furnace output.

WEST MIDLANDS JOINT ELECTRICITY AUTHORITY.—The Minister of Labour and National Service has given notice that as soon as may be after January 9th, 1940, he will designate to the West Midlands Joint Electricity Authority, in accordance with Section 2 (9) of Part I of the First Annex to the Schedule to the West Midlands Electricity District Order, 1925, the employees' organisations having members in the employment of authorised undertakers in the district, in order that the organisations so designated may choose a representative of persons employed in connection with the supply of electricity in the district to be a member of the Joint Authority. Any employees' organisation which is desirous of being considered by the Minister for designation should make application in writing to the Minister not later than January 6th, 1940.

HOT WATER AT THE FRONT.—A doctor writes: The soldier is continually suffering from the appalling discomfort of never being able to procure any supply of hot water to wash himself, his clothes, or his food utensils; and it is well known that the opportunity of a hot bath or shower bath is more appreciated by the average soldier than anything else; in fact probably the three chief essentials contributing towards a good morale of the troops are, good food, good clothes, and a means of keeping clean. He suggests that a mobile unit is desirable. The smaller and the more mobile the outfit the larger the number of Units that could be supplied, and less time and fuel would be wasted in moving this equipment from place to place. It would probably be advantageous to have two types; (1) A small plant for supplying hot water which the men can collect in canvas buckets and use for daily washing; (2) A more elaborate outfit for shower baths, which could be supplied to the larger Units such as a Division, and could travel round the various smaller Units in rotation.

## Air and Water

AMERICAN AIRCRAFT ORDERS.—Reports state that the British Purchasing Commission has placed an order with the Lockheed Aircraft Corporation for aircraft to the value of about twenty million dols.

NEW FRENCH AIR SERVICE.—A new French Air service has begun between Paris and Lisbon to provide a connection with the trans-Atlantic Clipper line. At first the service will be weekly, but will later be bi-weekly.

SHIPPING LOSSES.—During the week ended December 9th, fourteen ships aggregating 50,044 tons were sunk, and of these six of 23,432 tons were British. Four British ships of 22,368 tons were so long overdue that they were considered as lost.

TRAINING THE AMERICAN MERCHANT MARINE.—The United States Maritime Commission has acquired a new merchant marine training station in Florida and has begun a programme for training a limited number of apprentice seamen. It is intended to train 3000 unlicensed seamen and 500 officers a year, and apprentices to be trained in seafaring will be limited to 500 a year.

DESTROYER SUNK IN COLLISION.—The Admiralty has announced the loss of H.M.S. "Duchess" as the result of a collision with another naval vessel which was undamaged. She was a destroyer of the "Defender" class, with a displacement of 1375 tons. It is feared that 120 of her crew lost their lives. This is the third destroyer to be lost since the war started, the other two, the "Blanche" and the "Gipsy" having been sunk by mine explosions.

LLOYD'S REGISTER WRECK RETURNS.—According to Lloyd's Register Wreck Returns for the quarter ended June 30th last, the gross reduction in the merchant marine of the world from all causes was 83 ships, aggregating 198,924 tons gross. Of this total 53 of 104,084 tons were steam and motor ships, of which 13 of 34,890 tons were British. Vessels lost, condemned, &c., in consequence of casualty or stress of weather amounted to 26 of 93,545 tons.

APPOINTMENT OF MR. A. STEVENSON.—It is announced that Mr. Allan Stevenson has been appointed Assistant Director for Marine Engineering in the Shipbuilding and Repairs Division of the Ministry of Shipping. For many years he has been a director of David Rowan and Co., Ltd., Glasgow. He is a member of the committee of the British Corporation Register of Shipping and Aircraft, a governor of the Royal Technical College, and vice-president of the Institution of Engineers and Shipbuilders in Scotland.

POWERFUL THAMES TUG.—What is stated to be the most powerful craft of its kind built in the London area, the motor tug "S.A. Everard" has recently been placed in service. This tug has a length of 83ft., a beam of 21ft. 6in. and a depth of 11ft. 9in. Her eight-cylinder, two-stroke trunk type oil engines, built by the Newbury Diesel Co. Ltd., have cylinders 320 mm. bore by 426in. stroke, and develop 800 b.h.p. at 300 r.p.m. The vessel was built by Fellows and Co., Ltd., of Great Yarmouth and is capable of towing six 400 ton barges.

AMERICAN MOTOR TORPEDO BOATS.—A correspondent of the *Journal of Commerce* reports that the Electrical Boat Company has received from the United States Naval authorities a contract valued at five million dols. for motor torpedo boats. These craft, it is understood, will be constructed under licence to the designs of Mr. Hubert Scott-Payne, and will be similar to the 70ft. motor-boats which have been supplied to the Admiralty by the British Power Boat Company. A special factory has been laid down to deal with the contract.

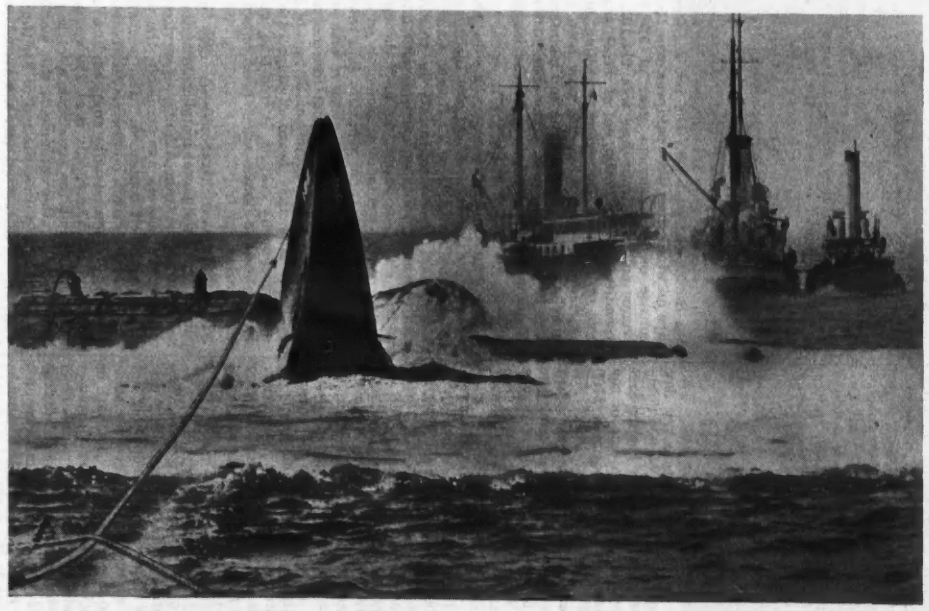
CLYDE LIGHTHOUSES TRUST REPORT.—At the annual meeting of the Clyde Lighthouse Trustees, it was stated that during the past year the net registered tonnage of ships on which dues were paid was over 15,923,900 tons, a decrease on the previous year of 925,130 tons. The revenue collected from dues was £14,193, and the total expenditure was £39,600, out of which sum £24,448 was spent on dredging, deepening, widening, and maintaining the channel. This work has now been completed, and only the expenses of dredging and maintenance would fall on next year's accounts. The channel was stated to be safe now for the navigation of the largest ships in the world.

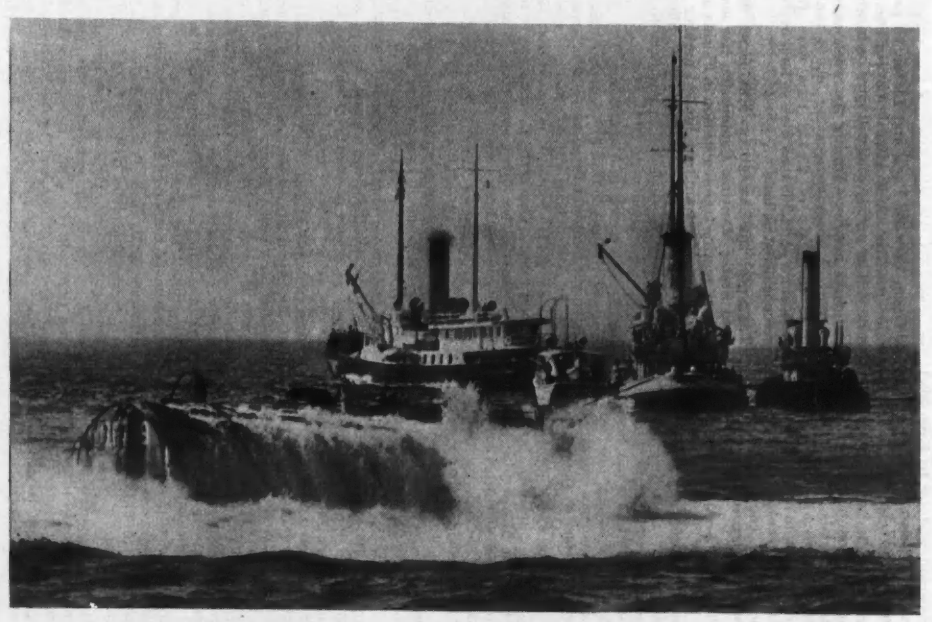
IMPROVED SHIP PERFORMANCE.—In the course of a paper before the North-East Coast Institution of Engineers and Shipbuilders, Major T. Russell Cairns said that the combination of improvements in machinery, coupled with the lower block co-efficients and improved lines of modern ships, appeared to have brought about performances that were almost incredibly superior to those of even twenty-five years ago. He said that in 1911–12, a fairly good average tramp steamer with saturated steam, natural draught and a contact feed heater, would carry 7000 tons at about 10 knots on 32 tons of fairly good coal per day. Now they heard of ships of about the same carrying capacity costing, it was true, very much more, that claimed to do the same speed on something like 20 tons per day.

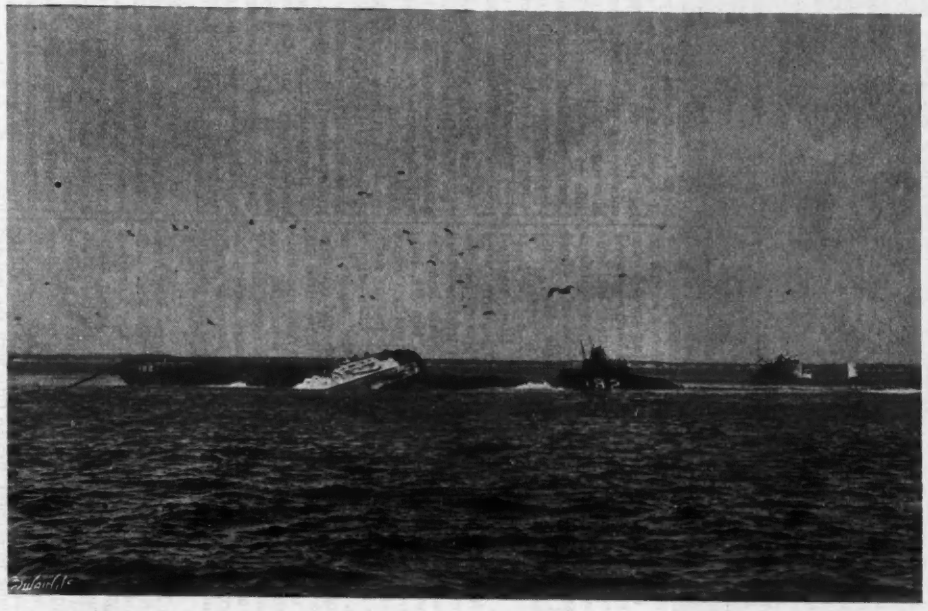
NEWFOUNDLAND AIRPORT.—A note in *Flight* gives particulars of the power installation at the Newfoundland terminus for the trans-Atlantic air services. As no power from outside sources was available, the whole plant had to be made self contained. The permanent equipment consists of four main oil-electric alternators, each rated at 80 kVA, and two standby units of 20 kVA, and 10 kVA respectively. The supply is at 230 volts, 50 cycles, and is used to feed all the aerodrome electrical services. This includes the radio equipment, the white beacon of 11 million candle-power, the red of 3½, the 16ft. high neon beacon, the 22ft. wind tee, the boundary lighting (with its two independent alternate circuits), and the runway contact lights. In providing power for a marker-beacon on the opposite shore of Gander Lake, which is 30 miles long and 2 miles wide, on the south-western boundary of the aerodrome, a line of cable had to be laid across the lake. This was found to be 960ft. deep. The high voltage and the tremendous water pressure called for a very high standard of construction in the cable, and splicing was not allowed; the whole 12,000ft. required was made in one length.

# SALVAGE OF THE U.S. SUBMARINE "SQUALUS"

(For description see page 606)







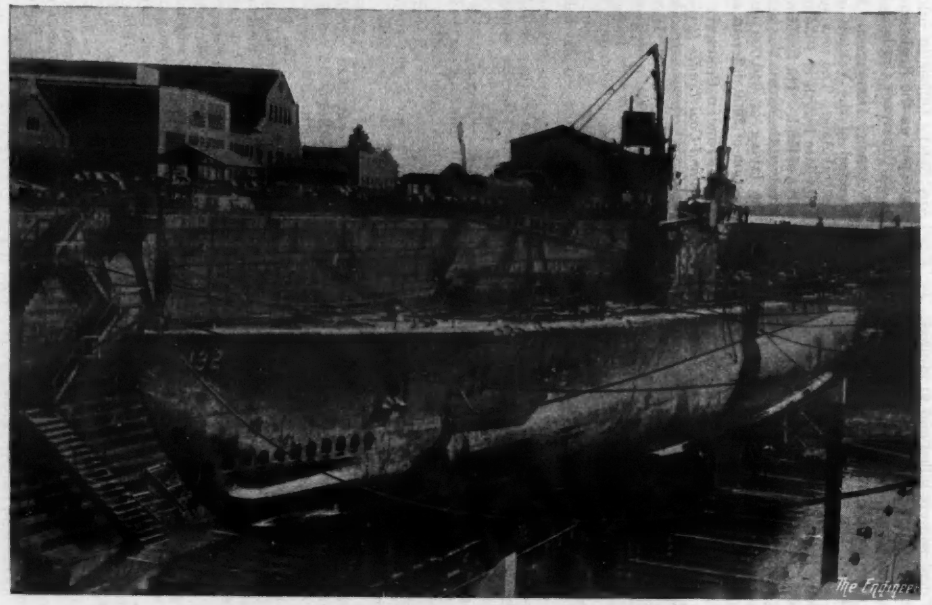



FIG. 8—BOW EMERGING DURING FIRST ATTEMPT, JULY 13TH
FIG. 10—SUBMARINE BROUGHT TO THE SURFACE, SEPT. 13TH

FIG. 9—PONTOONS COMING TO THE SURFACE
FIG. 11—SUBMARINE IN DRY DOCK

# The Engineer

*DECEMBER 22, 1939*

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**Until further notice THE ENGINEER is being printed and published at the works of Messrs. William Clowes & Sons, Ltd., Beccles, Suffolk. Telephone No. Beccles 2103.**

**To avoid delay all correspondence connected with Publishing and Advertising should be addressed to Beccles.**

**The head office, 28, Essex Street, Strand, W.C.2, is remaining open for Publishing and Editorial purposes from Mondays to Fridays inclusive from 9.30 a.m. to 5 p.m. where classified advertisements may be handed in as usual. The Offices are not open on Saturdays.**

**Copies of THE ENGINEER can be obtained at 28, Essex Street from Friday mornings.**

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*** *For Subscription rates, see page 2 of Advertisements.*

*** *All letters intended for insertion in* THE ENGINEER *or containing questions should be accompanied by the name and address of the writer, not necessarily for publication, but as a proof of good faith. No notice whatever can be taken of anonymous communications.*

*** *No undertaking can be given to return drawings or manuscripts; correspondents are therefore requested to keep copies.*

CHANGE OF ADDRESS

*** *Will Subscribers please note that in all advices regarding changes of address it is necessary to have* **both the old and new addresses**, *as our lists are kept alphabetically by towns. Advices of this nature should reach us by the first post Wednesday morning prior to the alteration.*

**Postal Address : "The Engineer," 28, Essex Street, Strand, London, W.C.2.**

**Telegraphic Address : "Engineer Newspaper, Estrand, London." Telephone : CENtral 6565 (10 lines).**


### THE WAR IN THE AIR

FOR his second review of the war in the air, presented in the House of Commons on December 12th, Sir Kingsley Wood, Secretary of State for Air, took the period beginning with the enemy raid on warships in the Firth of Forth on October 16th. He had little to reveal that was not already known, or could be inferred, by the public. Sir Kingsley suggested that the raid on the Forth marked the opening of the second chapter in the history of the war in the air, and that that chapter might now be drawing to its close. During the two months under review, there has been a steadily increasing degree of aerial activity on both sides, in spite of the difficulties imposed by the advance of winter. There have been no great aerial battles, but we have had to deal with a number of reconnaissance raids over or towards the shores of this country carried out by single aircraft or small groups of machines. There have been bombing attacks, mostly futile, against our naval stations in Scotland, but there has been no attempt so far to unleash the fury of an aerial assault against any of our principal centres of population or industry. We in our turn have been active in raiding the enemy's air and naval stations at Heligoland and elsewhere, and have carried out numerous reconnaissance flights deep into Germany, visiting Hamburg, Bremen, the Ruhr, Berlin, Munich, and Nürnberg, and some of these places on more than one occasion. Sir Kingsley was able to record that the Germans in their raids on this country have suffered very high losses relatively to the number of machines employed whereas our aircraft on similar missions have escaped lightly. In other words, our fighting aircraft have proved themselves well able to deal with anything in the shape of bombers which the enemy has so far sent against us, whereas our bombers on more than one occasion have demonstrated that they have the power to engage and defeat the enemy's fighters. When fighter meets fighter, our "Hurricanes" and "Spitfires" have shown superiority over the "Messerschmitts" in gun power, control, and manœuvrability at high speeds.

At sea our aircraft have continued to play their part in protecting convoys of merchant ships, and in the course of that work have on many occasions engaged and shot down enemy machines. They have also continued to take their share in defeating the submarine menace. On 57 occasions submarines have been attacked from the air, and in 19 instances it is certain that substantial damage was done. Although Sir Kingsley Wood did not refer to the fact in his remarks it became known soon after he spoke that another duty had been entrusted to the Air Force, namely the maintenance of "security patrols" intended to hamper the enemy's employment of aircraft for the purpose of sowing mines in the ocean fairways. On the question of production of aircraft and aerial equipment, Sir Kingsley naturally spoke with caution. He revealed, however, that the numerical output to-day was more than twice what it was a year ago and that the machines now leaving the factories were many times more efficient as weapons of war that those which preceded them. On the outbreak of war our home defence organisations, consisting of anti-aircraft guns, searchlights, fighter squadrons, balloon barrages, and observer corps, constituted a complex system which had been developed in peace time, and which had never been fully tested on a nation-wide scale on peace manœuvres. It has now been welded, after a hundred days of war, into a system under the control and command of one commander-in-chief. The system has been given invaluable practice in dealing with the enemy's sporadic raiding of our shores, and many members of the public from their own observation can support Sir Kingsley Wood's assertion that it has proved itself efficient and adaptable.

This second chapter of the war in the air contains much that is encouraging, but it would be unwise to regard it otherwise than as coinciding with a period of testing, a preliminary sparring for position, largely intended to discover the possibilities and limitations of modern aerial warfare and the dispositions of the other side. Sir Kingsley cautioned us that the chapter may be drawing to a close, and that perhaps soon, perhaps in the spring, a more strenuous and difficult chapter may open. Recalling the experiences of the last war, we remember the sway of aerial supremacy from one side to the other until it settled finally on ours. Aeronautics in those days was in a nascent state when great advances were readily possible and could be secured fairly quickly and cheaply. To-day development has been pushed up to a point which makes further advance a slow and costly business. Further, the knowledge of aeronautical science is now so widespread that it is impossible to believe that either we or the Germans could for long retain undiscovered any fundamental development imparting marked superiority to the machines of the side making use of it. If, for example, the German "Messerschmitts" possess, as has been stated on good authority, poor manœuvrability at high speeds, and a tendency to develop wing and tail flutter, it is most unlikely that immediate steps will not be taken to effect an improvement in these respects. Again, if the geodetic system of construction adopted in our long range "Wellington" bombers imparts outstandingly valuable characteristics it is substantially certain that the system will be copied by the enemy. How long the present apparent supremacy of our aircraft over the Germans' will remain, depends upon the speed with which the enemy can adapt his works to new designs or systems of construction. Fortunately, too, it will also be influenced by our own ability to produce improved aircraft. Above all, perhaps, it will depend upon our ability to maintain a flow of first-class pilots to the Air Force. On that point, at least, we may, in view of the grandly conceived scheme for the recruitment and training of pilots from the whole of the British Empire, feel no doubts.

### Export Trade and Munitions

THE secret session of the House of Commons on Wednesday, December 13th, was devoted to Supply. It was intended to give members an opportunity to air their criticisms and to enable them to hear the apologia of the Government. No one is supposed to know what happens behind the closed doors at Westminster when "strangers," including the Press and even Hansard, have been ejected, but despite all the warnings of the Speaker and the threat of dire penalties if, even on the conjugal pillow, secrecy is broken, some leakage is certain to occur. That anything really secret will be revealed is unlikely. The elements of the problem are already known; criticism has already been freely expressed, and the Government said weeks ago all that it is likely to have said in a "tiled" House. It was the wish of the Members that the session should be held, and it is not improbable that they had more to say about each other than about the Government. On only one point could the Government give definite information to the House; that is on the adequacy or otherwise of the present rate of production of war materials of all kinds, and the adequacy of the rate of acceleration where the present rate is below the maximum aimed at.

It may be that the Government was able to assure the members that it had no anxiety. It may have pointed to the fact that aircraft were being turned out in double the quantities of last August, and that supplies of engines and frames were coming in now, or would arrive shortly from overseas; it may have repeated Mr. Churchill's statement about the rate of production of new ships of war and commerce; it may have reminded members, who are especially concerned about the output of shells, that it is fruitless to pile up shells until enough guns to use them are complete. Every gun according to its size and ballistics has a definite life measured in numbers of rounds. At the end of that life it has to be returned to the base to be relined. To turn out shell regardless of this limitation on their use would be uneconomical. On such matters as these the Government may have been able to reassure the House. But there is another consideration of the very first importance which was, no doubt, discussed. It is not sufficient that we should turn out shot and shell and ships and aeroplanes in ever increasing quantities.

Even if we could hasten the end by giving the country up wholly and solely to munitions, we should find ourselves in sore straits when the war was over. We should have lost our markets, our credit would have fallen to pieces, we should be unable to buy from abroad, and be unable to produce manufactured commodities at home. A Peace on those terms would be deplorable. The maintenance of large overseas trade is essential, and the satisfaction of markets formerly supplied by Germany is desirable. Hence it is imperative that we should be in a position to produce not only all the munitions required, but that we should be able to carry on an adequate production of things for home consumption, and a considerable volume for export. The President of the Board of Trade was fortunately able on December 7th to give a very good account of October's export trade, but until we are assured by a repetition of such records that October was not exceptionally favourable can we rest easy on this score. Put broadly, the position then is this. We must be able to do rather more than continue business as usual, and we must be able to satisfy the requirements of the fighting forces. The problem to be solved is not one of man power alone; equipment is a very important factor, and in a leading article in our issue of November 17th we indicated the advantages of working the full night shift. Three shifts are already being worked to a certain extent, but even if a generous allowance is made for what is already being done, it remains true that the total output of the country could be increased with the existing equipment by something like 33 per cent. if the three-shift system were made universal.

One may hear it said in certain circles that "War is War" and that to talk of business as usual is almost a criminal offence. Those who express these views seem to forget that without present business the war cannot be paid for, and that without future business the peace would be ill won. Business must be maintained up to that point where further prosecution of it would hinder the supply of men and material for the forces. As Mr. Oliver Stanley said on the occasion to which we have already referred, "In the matter of priority, Service requirements must be given some preference, but he would not admit that every Service requirement must have priority over every civilian requirement." That statement was applauded by the House. It is a welcome indication that the Government recognises that we cannot afford to think War and nothing but War. That course would lead to ultimate disaster. Our war effort must be regarded as supplementary—in as far as possible—to our daily work and nothing should be left undone, even such services as are performed by the Institutions and the technical and trade Press to foster the advancement and development of business. The business man, too, has his part to play. It may be easier and pleasanter to accept Government contracts, but wherever those cannot be regarded as essential, producers should be seeking to satisfy familiar markets and to fill the gaps in other markets which have been caused by the destruction of Germany's overseas trade. The sinews of war are commerce, and unless trade is prosecuted we shall lack the money, as already our enemy is beginning to do, to continue the struggle. On December 7th Mr. Amery expressed a fear that not only were we not carrying on business as usual, "but that we were not taking advantage of our opportunities and of our desperately urgent necessities to do much more business, and to do a great deal of unusual business."

# Literature

*Operation Analysis.* By HAROLD B. MAYNARD, M.E., and G. J. STEGEMERTEN. London: McGraw-Hill Publishing Company, Ltd. 1939. Price 18s. net.

THE main purpose of this book is to show how the productivity of labour may be increased, not so much by the introduction of new machinery and plant—important as that undoubtedly is—as by the careful analysis of all methods and processes, with a view to making them as efficient as possible. Its value is much enhanced by the manner in which the application of the principles enunciated is illustrated by typical examples taken from a number of different industries. The opening sentence "Methods engineering is an essential part of scientific management" gives a clear indication that the subject is approached from the American standpoint, for speaking generally, the "methods engineer" is not known in this country, although his activities are evident in other guises. In the words of the authors, "methods engineering is the industrial science which is chiefly concerned with increasing labour effectiveness," and is essentially "the technique that subjects each operation of a given piece of work to close analysis in order to eliminate every unnecessary operation, and in order to approach the quickest and best method of performing each necessary operation."

The authors claim that the principles set out are those of simple common-sense, and are readily understood by the practical man of the workshop; but while this may be so, the average man does not approach his problems in a methodical way unless he is given some guidance in assisting him to think for himself along right lines. Accordingly, a large number of pertinent questions are raised on each subject which the reader will do well to consider for himself before turning to the suggestions made for him. Credit is given to Dr. Frederick Taylor for his early experiments in "time study" which led to the further researches of the Gilbreths, who devoted their lives to developing the technique of motion study and evolved the system of "therbligs," the basic units of accomplishment.

The value of careful operation analysis is stressed, and different ways in which methods studies can be conducted are carefully explained; it is correctly pointed out that when an order is not likely to be repeated there is not the same justification for making an exhaustive operation study as there would be if the work were of a highly repetitive character with further orders envisaged. Accordingly, six different types of methods study to meet the varying conditions are proposed and described in detail. The simplest is the quick application of some form of standard data for the purpose of setting a rate on a non-repetitive job, whereas the most complex will involve a thorough job analysis of every component, motion study coupled with the use of the cinematograph, standardisation, and a complete time study.

The making of appropriate charts affords a very useful adjunct and gives the busy manager an easy means of judging the work that is being performed. That conservative executives are often opposed to the use of process charts was demonstrated in an amusing way when Frank Gilbreth, who was seeking to improve the methods of a certain firm, just spread out a long process chart on the desk of the works manager. This official, with scarcely a glance at it, exclaimed, "I can tell you right now that I won't approve it, whatever it is. It is entirely too complicated." Gilbreth readily agreed, and pointed out that it happened to be a process chart for the firm's procedure at the moment, and not proposals for the future! We would suggest that it is always good to make a process chart for a job as it stands before making out the ideal; the comparison is often very instructive.

Certainly an excellent case is made for careful operation analysis, and it is clearly shown that many operations have been eliminated as the result of it, but even after it has been proved that a particular operation is redundant, if the plant has apparently been running sweetly for some time, there is an evident reluctance on the part of the works people to adopt the change. After all, it is very easy for additional operations to creep in to meet some special circumstances, and thenceforth to remain as a recognised link on the production chain. Not only does good analysis throw up nugatory work, but it should also bring into relief the time that is lost in unnecessary or irregular inspection, in bad transport arrangements, bad handling of work, and the like; while on the other hand it will suggest the value of standardisation, and also of each operative thinking for himself and developing a constructive attitude towards his work.

Perhaps in no other sphere can careful operation analyses be of more use than in determining the correct "set-up" of work and tool equipment; an informative chapter is devoted to this important subject. Another chapter concerns itself with ten recognised possibilities for operation improvement which are likely to occur in many factories that are occupied with mass production. Photographic illustrations help to confirm the value of the suggestions.

However thorough the work of the analyst may be it is seriously hampered if the original shop lay-out has been a bad one, and though this cannot be entirely cured in an old established works, when new ones are contemplated, much care should be taken in determining the best lay-out. For this purpose it is suggested that each shop should be carefully set out on the drawing board, and models made of each machine, so that they can be shifted about to different locations until the most efficient one is selected. The authors suggest small photographs of the machine mounted on card, but we have found lead models ideal. They are easy to move about, while their expense is fully justified, if it results in an "ideal lay-out" being evolved.

In concluding, the authors make the categorical statement, "It should be remembered that any job can be improved if sufficient care is given to it. This is literally true." We agree, and this being so, the time spent in taking stock of the position is time well spent, and all production engineers in this country would do well to pay more attention to the subject of operation analysis, for which purpose this book can be recommended. If they are not prepared to act on all the suggestions made, or to employ all the charts and diagrams with which this work is profusely illustrated, they can at least adapt them to their individual requirements.

*Factory Lay-Out, Planning and Progress.* By W. J. HISCOX. London: Sir Isaac Pitman and Sons, Ltd. 1939. Price 7s. 6d. net.

THE main theme of this book is one that has never been fully explored, and we are glad to find in it the considered scheme of a man who has brought to bear an extended workshop experience coupled with an intelligent observation of difficulties likely to be experienced, and the best means of overcoming them. It is a treatise which can be commended to the perusal of the works manager who wishes to enhance the reputation of a firm by a better keeping of promises and by improving the quality of the product, while reducing its cost.

The volume is divided into two parts, the first dealing with planning and routeing of work, and the second with the subject of progressing it. The reader is at once introduced to the sphere of shop lay-out, and the desirability of ensuring an uninterrupted flow of the product, so that raw material passes from rail or road through the store into the foundry, which is adjacent to the machine shop, which in turn abuts on the fitting shop, next door to which is the erecting shop, followed by inspection and dispatch. Too often geographical considerations, haphazard extensions to shops, temporary additions which have become permanent, and many other drawbacks hamper the manager, who finds himself merely longing for the ideal! The necessity for a centralised tool-room is stressed, and certainly we are surprised that many engineering firms have not yet admitted this, but again its location is important. The author advocates the grouping of machines according to class, but we suggest that there are many inherent disadvantages due to excessive transport, and we should rather favour line production.

The allotment of staff duties is clearly depicted, but their relations one with another are not so clearly defined; for this purpose a "family tree" showing the importance of each function is invaluable. We are rather surprised to find a statement that in small factories the estimator can be dispensed with, for we maintain that good estimating is as essential to a modern works as is good cost accounting; the two should go hand in hand. Costing is only briefly mentioned, yet nowadays each member of a works staff should know something of this important function.

A useful chapter on production planning contains the remark that "to be really effective it must commence with design, and if the design

has been in existence for some years it must be subjected to a drastic overhaul." We agree; too often planning only begins after the drawing-office stage has been passed. The author's suggestions for investigating every possible source of wasted effort, and many other questions arising in workshop routine, are both useful and pertinent. Production planning is largely a matter of organised common sense, and this opinion seems fully endorsed by the author, if not in so many words. The methods advocated for the routeing of work, with the help of control boards, are both simple and thorough, this section being well illustrated by helpful charts and diagrams.

When we reach the subject of progress work the author affirms that "the 'progress' idea has taken root in this country, and it is growing fast." This is admitted, and we congratulate him that he has not attempted to foist on the reader any of the grandiose ideas originating from the United States, but has rather given him the benefit of the results of practical experience expressed in the initiation of a straightforward system suited to British industry.

Again we should like to see the official status of the progress man more clearly defined, particularly in relation to the shop foreman, with whom he must always retain close touch, while not possessing the same degree of authority in the workshop. He will frequently find himself opposed to the foreman, and yet he must endeavour to enlist his sympathy and support; unless the possessor of consummate tact a man is likely to prove a failure in this work.

We are glad to observe that the issue of progress routine to meet exceptional circumstances has neither been ignored nor lightly brushed aside; it must always be recognised that the rush order can never be eliminated, but unless such orders are properly handled they are likely to prove disastrous to all the other work passing through the factory. "It is an easy matter to rush through the details comprising one order if the claims of all other orders can be disregarded for the time being, but this is not permissible." In this connection we are particularly interested in the special card proposed by the author, in that it is printed in a distinctive way with the word "Lightning" boldly displayed on its face, while on the back will be found what purport to be flashes of lightning! This card has to be treated with the utmost respect, for it authorises work on a machine to be stopped, even though this involves the resetting of that machine. To safeguard this special procedure from abuse every operation shown on the card must be signed by the foreman or responsible official. Provision is also made for the cancellation of rush orders.

The value of reports is emphasised as well as the necessity for their being rendered promptly and for containing accurate information; we might also add a plea for brevity and apposition; it is fatal to rely on memory; all reports to the management should be "above board," and signed by the writer. A good and systematic daily record is to be recommended, and should be kept even if there is nothing adverse to report. An efficient progress man should have the capacity for intelligent anticipation of events that are likely to occur. Some instructive examples of progress reports are given in the text. In effective progress work "short circuiting" will never help, but there is always a tendency to resort to this expedient.

The author concludes a useful, interesting, and informative book with some notes on the personal relationship of the progress man with various officials, and he rightly points out that tact will succeed where bluster fails. "The progress man who is quietly confident of ultimate success is fully conscious of his disabilities due to lack of experience, but repeated rebuffs make him the more determined to succeed. . . . He recognises the status of those with whom he comes into contact, pays tribute to their experience and the positions they occupy, and sets out to become worthy of their regard." Again we read that "the schoolboys' dictum of 'never sneak' is a most important factor, and will, if assiduously practised, do more than anything to secure goodwill." But on the other hand we are warned that the workshop is no place for one who fawns on his superiors. Perhaps the citing of these few opinions of the author may serve to reveal his personal outlook on industry, an outlook which might well be emulated.

## BOOKS RECEIVED

*The Institution of Electrical Engineers' Regulations for the Electrical Equipment of Ships.* London: E. and F. N. Spon, Ltd., 57, Haymarket, W.C.2. Price 2s. net paper, and 3s. net cloth covers.

*Canteens in Industry.* London: Industrial Welfare Society, 14, Hobart Place, S.W.1. Price 1s. net.

*Minerals Yearbook*, 1939. Washington: United States Government Printing Office, D.C., U.S.A. Price $2 net.

*The Design of Flat Plates.* By C. C. Pounder. Epsom: Draughtsman Publishing Company, Ltd., 1, Links Road. Price 2s. net.

*The Mechanic's Repair Shop Manual.* By H. J. Dyer. London: Percival Marshall and Co., Ltd., 60, Kingsway, W.C.2. Price 2s. 6d. net.

*The Beginner's Guide to the Lathe.* By P. Marshall, C.I. Mech. E. London: Percival Marshall and Co., Ltd., 60, Kingsway, W.C.2. Price 1s. 6d. net.

*Manning Formula Tables for Solving Hydraulic Problems. Volume 2.—Flow in Open Channels.* By H. W. King. London: McGraw Hill Publishing Co., Ltd., Aldwych House, W.C.2. Price 30s. net.

## Letters to the Editor

*(We do not hold ourselves responsible for the opinions of our correspondents)*

### INTERNAL COMBUSTION TURBINES

SIR,—In the issue of THE ENGINEER dated September 22nd, 1939, on p. 302, a letter of Mr. Hugh Campbell is reprinted stating that the axial flow blower made by Messrs. Brown, Boveri and Co. "seems to be only suitable for pressures of 5 to 10 lb., and is incapable of dealing with heavier fuels which a turbine should utilise to obtain the greatest economy."

We should be much obliged if this statement could be corrected as follows:—

104 multi-stage axial blowers have been built and are built at the time being by Messrs. Brown Boveri and Co., with volumes of air ranging from 1700 to 125,000 c.f.m. and with pressure ratios up to 4·8 with air and 7 with methylene chloride $CH_2Cl_2$.

Bunker oil C can be used with advantage in gas-turbine-installations.

BROWN, BOVERI AND CO., LTD.
H. MEYER.

### ENGINEERING EDUCATION

SIR,—Professor Parker Smith's address raises questions not only of interest to engineers, but to professional men generally. Some of the ground is covered in my letter in your issue of October 13th last.

What I am mainly concerned about is to bring order into professional chaos. As Lord Passfield pointed out a generation ago, there is no federation of the professions, as in the case of Trades Unions, not even an annual congress.

The examination question is not peculiar to engineers. It arises in a similar way for architects, doctors, and other professions.

Founded, as the Universities generally were, primarily to teach theology, the ecclesiastical authorities were dominant over them. In many, without passing religious tests, men could not be admitted to them. Later the faculties of law and medicine were added. For a long time it was held that there were only three learned professions—theology, law, and medicine, a position that was maintained occasionally, as circumstances allowed, by judicial dicta. Mechanical development has since provided the rest.

Theology has ceased to be dominant, medicine has expanded and law must always be a basic study. Of the newer professions, engineering in all its varieties and ramifications takes a high place. Architecture, teaching, property technique, and others fulfil important functions. Why is the engineering group not federated? Why is the allied land group not federated? Why are all the groups and singular professions not federated? The answer is irrefutable. They neglect their common interests.

There is an unnecessary multiplication of examining bodies for medicine, and it is not matter for wonder that the Medical Practitioners' Union should have been formed to obtain a uniportal system. On the question of universities versus colleges as modes of qualification, there is no doubt it should be either the one or the other, not both. There is much substitution of examinations. Part of an examination by one body may be excused if another body has examined the student in similar subjects. There is obvious redundancy, obvious need for amalgamations. It may be that State control of education through all its stages, from the elementary school to the University, is the solution of the problem. The proposed Federation of the Professions would then make representations to the State.

The National Council of State Boards of Engineering Examiners for America is well on the way to providing uniformity of tests in the Universities. It would be well for British engineers to study its operations. America, as a new country, can develop its organisations *de novo*, unhampered by the long traditions that govern old countries.

There is much overlapping in engineering, architectural and land professions. The technical press exhibits constant rivalries as to which should be paramount. These are undignified professionally and harmful to the best interests of the State.

Italy has grouped all its professions into one Corporation. They are now occupied in delimiting their respective provinces. If they cannot agree on any point, a higher tribunal decides.

Federation is the topic everywhere to-day. National rivalries will compel it. Federation within a country should really precede Federation without. The exigencies of war may reverse the process.

Internal federation should eventually lead to International Federations of labour (partially achieved already) and to professional federation (now only in its infancy) so that all sections may give of their best to the whole world.

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18, Campfield Gardens, N.W.6.

### GAS POWER IN WAR TIME

SIR,—It is satisfactory to learn from your correspondent, Mr. G. H. King, that my plea for the recognition of the pioneer has not been altogether wasted, the lay Press is always ready to accept the work of later labourers in the same vineyard as original, and to report it as such, and it is interesting in the support of truth to get first-hand statements of the work of the pioneers which, in this case, was far advanced nearly twenty years ago, as Mr. King's letter proves.

Since the advent of oil power, gas has had to take a back seat to the detriment of this country's pocket in very many cases. In particular does this apply to pumping by gas power, and I am in possession of a paper read by a well-known consultant in America on the Steckel gas pump, a two-cycle adaptation of the Humphrey pump, which describes in detail the results obtained with an elaborate demonstration staged by a well-known American company, which has developed this pump to deal with lifts between 15–150ft. with remarkable success, a special intensified action being incorporated for lifts above 60ft. The pioneer, the writer, also succeeded in producing a successful two-cycle action in 1930, but whatever chances it had of commercial success were killed by the ensuing world slump, and the system was never demonstrated in a truly representative plant. The Steckel system is, however, thoroughly proved, it has been commercially applied with success up to 325 pump H.P. against a lift of 125ft. and though it is probable that the simpler construction possible for lifts not exceeding 50-60ft. commend this form of pump most strongly, the fact that this plant was employed on the important service o cooling blast furnaces is evidence of its reliability even on high lifts, and it is difficult to understand the reluctance of British makers to examine its claims.

For all such purposes as land drainage, for example, its low capital cost should make a strong appeal, and in this connection it may be of interest to state that a tender was prepared some years ago, covering the construction, erection, excavations, foundations, and building, for a 1730 pump H.P. unit intended to operate a hydro-electric station on blast furnace gas, the total cost of which works out at £19 per pump H.P.

So far as I am aware no engine-driven plant could be offered for much less than twice this figure to cover the same items enumerated, and for a like pumping duty, and in making this deduction I have off-set the cost of the hydro-electric equipment against the cost of gas producers, and which amounting to £6000, exclusive of their installation cost (all included in the tender figure), provides a very ample margin for the gas plant.

So little is gas power appreciated, that when recently inviting attention to its possibilities for a drainage scheme in contemplation, I was advised that gas power could not be considered because "independance of power was essential," but surely no plant in the world can be more "independant" than one operating on producer gas in a coal bearing country, instead of on imported oil fuel, the price of which is soaring weekly under war conditions.

S. P. CHRISTIE.

P.S.—The Paper in question was read by its Author before the annual meeting of the A.S.M.E. in New York in 1933 and published in abridged form in the June issue of *Mechanical Engineering*, 1934.

# Automatic Boiler Control

THE principles of the Hagan system of automatic boiler control have been described already in several articles in this paper. It will be remembered that it uses compressed air, oil, or water as a power and control medium, and that it is claimed that there are distinct advantages of such a medium over electricity. It is said by James Gordon and Co., Ltd., which supplies the equipment, that it provides a quicker reaction and variable speed of control, and that it has an inherent simplicity as compared with electrical systems. The compensation of the Hagan pneumatic or hydraulic regulators can be

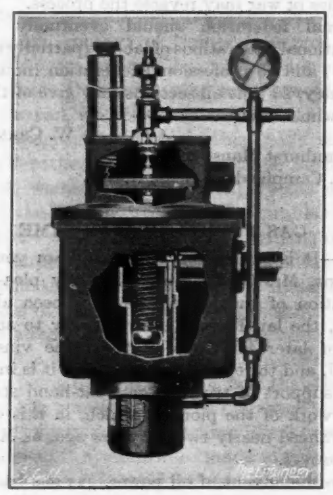


FIG. 1—DIAPHRAGM REGULATOR

either from the position of the control point or from the regulated value, so that, depending on conditions on site, the Hagan system can be a so-called "position control" or a "metering control." It is the purpose of this article to mention some recent developments of the system.

One of the interesting recent developments is the Hagan Diaphragm regulator (Fig. 1), which has replaced a regulator with floats for measuring and maintaining draught, air, or gas pressures, as well as differential pressures. For the new regulator a large diaphragm, balanced by an adjustable spring is used for measurement of the condition to be maintained. A movement of this diaphragm resulting

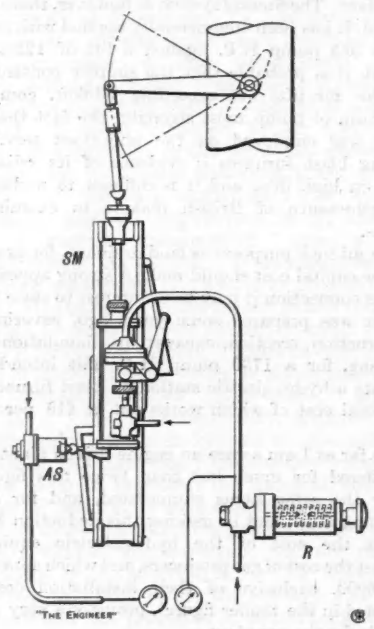



FIG. 2—DAMPER CONTROL

from a change in the regulated pressures causes a corresponding movement of a small control valve, which receives an operating medium at a constant pressure, and sends out a control pressure which varies corresponding to fluctuations in the regulated pressures. The diaphragm regulator can be equipped with a hydraulic stabiliser, the addition of which facilitates control problems like draught control by means of fan speed, where a certain delay in reaction may otherwise cause instability.

Where the regulated pressure has to follow variations in some plant conditions, the diaphragm regulator is fitted with a loading device which receives a control pressure from another regulator measuring that condition. This device embodies a cam, so that any relationship between the loading and the regulated pressure can be obtained. The purpose of this cam may be exemplified in connection with the problem of fuel-air ratio control. Some control systems base their method of operation on certain assumed laws regarding the interconnection between steam pressure variations, differential draught, and boiler load. Though perhaps correct theoretically, it is claimed that such systems do not take into account the many influences which modify these laws, and that with such systems the desired result can therefore not be obtained under all conditions. The Hagan system does not rely on any such assumption, but after the most favourable relationship has been established by tests conducted for each case under the existing operating conditions, this relationship is then duplicated by means of the cam mentioned. The results with Hagan control, it is claimed, will thus obviously be closer to the ideal conditions than those obtained by any other conceivable method of co-ordination between fuel and air.

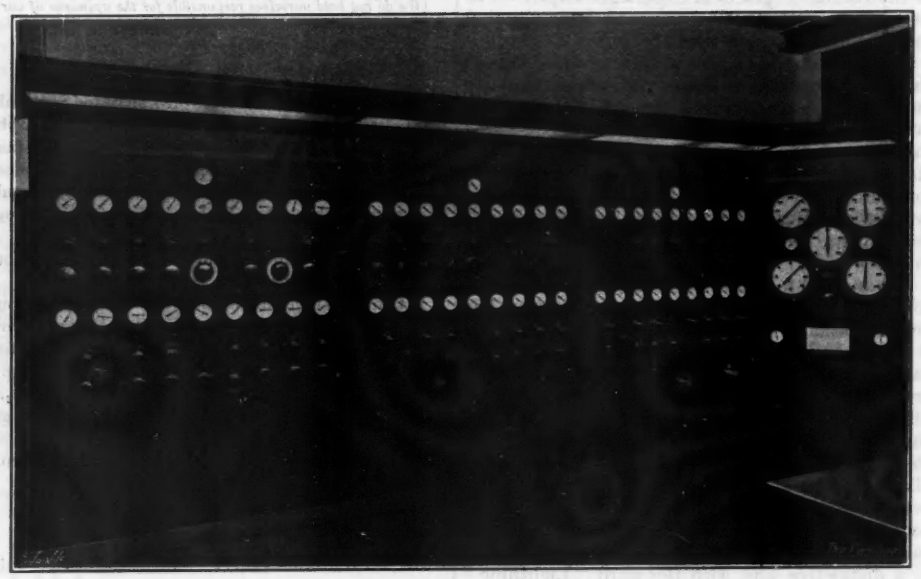


FIG. 3—CONTROL PANELS FOR PULVERISED FUEL BOILERS

### ACKNOWLEDGMENT CONTROL

The object of acknowledgment control (Fig. 2) is to enable the attendant to make certain that everything is working normally simply by looking at his gauge. If, for instance, a damper should be sticking, then the acknowledgment control would immediately indicate this condition. In the standard gear a sender valve, either attached to a regulator or hand-operated relay, sends a control pressure to a receiving device of a servomotor. The acknowledgment apparatus consists of a sender valve attached to the servomotor. To send out an acknowledgment pressure equal to the control pressure, the servomotor must have correctly responded to the latter. If the servomotor cannot function properly the two pressures will be different. Both pressures will be shown on guages so that the attendant can see what is happening.

### TEMPERATURE CONTROL

In the realm of temperature control great progress has been made in dealing with regulation of systems having a considerable time-lag between a change in heat input and its effect on the final temperature, or between an adjustment of the control gear and the actual change in heat input. The patented Hagan arrangement consists in principle of a dual control of the heat input. The final temperature which has to be kept constant forms one controlling factor, while the other one may be, for instance, the initial or an intermediate temperature, or the flow of the fluid or the flow or temperature of the heating or cooling medium. This secondary control is of a temporary nature, and acts only whenever a change occurs. The regulator measuring the secondary factor will send out a control pressure gradually fading away after a certain period which can be adjusted according to the time-lag inherent in the controlled system. This sort of control, it is claimed, will actually anticipate any future change in the final temperature which, therefore, will be maintained within much closer limits than hitherto possible. The same principle can, of course, also be applied to a number of other control problems, which, owing to the time-lag, have been difficult to solve.

For control of superheated steam temperature by means of attemperators or steam coolers, apparatus is now available which works intermittently, measuring at regular intervals not only the deviation of the temperature from normal, but also the tendency in the temperature change.

### BOILER CONTROL INSTALLATION

A Hagan boiler control installation recently completed is that for three 145 tons/hour pulverised fuel fired boilers at the Amsterdam Power Station, where altogether six pulverised coal and two oil fired boilers are equipped with Hagan control. On the new boilers the automatic control includes regulation of the coal feeding device of four mills, the total air quantity by means of a vane control of two forced draught fans, the primary and tertiary air by means of dampers, and the furnace draught by regulation of the I.D. fan vanes as well as the fan speed. Additional manual remote control has been provided for dampers at the outlet of the economiser and air heater so that the temperature of the superheated steam can be regulated by regulating the gas flow. Figs. 3 and 4 show the control panels for the three pulverised fuel fire boilers, and the control of the vanes of one of the F.D. fans mounted on the roof of the boiler house.

### FEED PUMP CONTROL

In Fig. 5 is shown a simplified diagram of the feed pump control incorporated in a control installation in a French Power Station. It works in connection with a Copes level regulator F and G. Steam and water flow are measured by two differential pressure regulators A and B respectively. Regulator A loads regulator B by means of a control pressure corresponding to the steam flow, and regulator B therefore

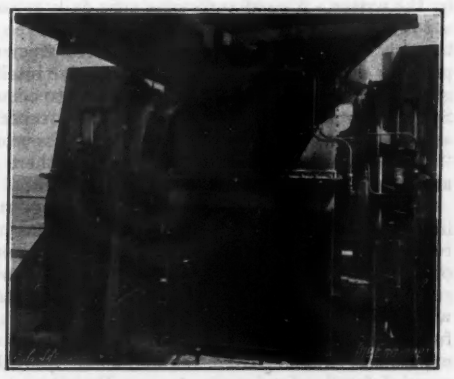


FIG. 4—VANE CONTROLS OF F.D. FANS

operates control valve D by means of servomotor C, so as to maintain a waterflow in accordance with the steam flow. The relation between water and steam quantity is, however, continuously adjusted by the water level as measured by the expansion and contraction of the Copes thermostat, which, translated into control pressures by regulator E, are used to load regulator A. Thus a high water level has the same effect upon regulator A as a decreased steam flow, decreasing the water flow through the medium of regulator B, and vice versa. The Copes regulator F finally adjusts the Copes valve G according to the water level, but the secondary adjustment will be relatively small, and therefore more exact, owing to the primary flow control.

This scheme is basically different from other systems which, though in principle using the same elements,

apply them in a different order. For instance, in systems where both the level and the flow impulse dually control the water valve, no exact level control is possible. To make this clear, assume that the water is at its correct level, but that the water flow exceeds the steam flow for some reason or other. Then there would be no level impulse in either direction, but the flow impulse would call for "less" water, and would consequently lower the level which would in turn create a level impulse for "more" until eventually the equilibrium is restored at a level somewhere below the level assumed as correct. Therefore, a momentary disturbance may result in a permanent maintenance of incorrect conditions.

In the scheme referred to in Fig. 5, however, the same disturbance would cause a re-adjustment of the ratio between water and steam flow, with the result that even without the assistance of the Copes

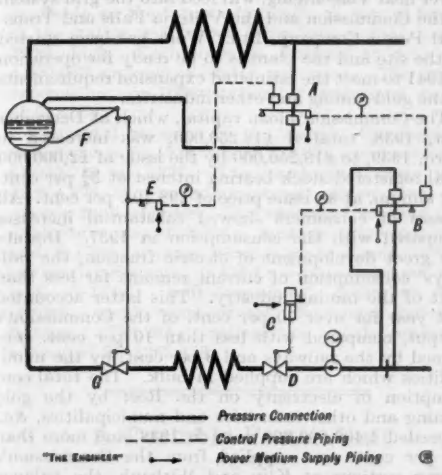



FIG. 5—DIAGRAM OF FEED CONTROL

valve, the water flow would just maintain the correct level.

Another interesting installation to be put into service shortly is the automatic control of two 200,000 lb. per hour stoker fired boilers working at 650 lb. per square inch steam pressure at the Bradford electric power station. The induced draught is regulated in relation to the steam pressure by means of a master regulator, relays and servomotors operating the inlet vanes of the two Howden fans, and by the automatic speed change of the two-speed motors driving these fans. The secondary air is regulated by the same master regulator and a servomotor operating a damper, while the F.D. fan vanes and the speed of the F.D. fan motors are controlled from the furnace draught. To maintain the air-fuel ratio the stoker speed is controlled from the flow of air to the grates measured by a diaphragm regulator.

The interesting feature of the installation is the connection between the control of the two high-pressure boilers and that of a number of older boilers working at 200 lb. per square inch. The object of this connecting link is to keep the new boilers steaming as far as possible at their most economic rate, but at the same time to use these more flexible new units to assist in meeting sudden load changes.

The boiler house of Warren Road Hospital, Guildford, with three Super-Economic boilers with Hodgkinson coking stokers, is illustrated in Fig. 6. Hagan control in this plant comprises the control of the

FIG. 6—BOILERS WITH AUTOMATIC CONTROL

individual boiler outlet dampers, and the speed control of the common stoker drive shaft, by means of a P.I.V. variable speed gear. As only one single water-operated regulator is used for the whole plant, the initial costs were very low. Automatic control installations may well find an even wider application under war conditions as a safety device in case of air raids. When the alarm is given, the boiler load will in most cases, drop considerably within a very short period. Automatic control will then automatically reduce the rate of firing and keep the steam pressure from rising and thus prevent the safety valves from opening. This, apart from the waste of steam, would have the effect of producing a cloud above the factory, attracting the enemy aircraft. Hagan control further allows the boiler house men to withdraw to their shelter. When the "All clear" signal is given the load increases rapidly, and the output of the boilers can be increased more rapidly with automatic control than by hand. When normal times have come back, this control will be useful in making the fuel saving which then will be more necessary than ever to recover some of the wastage in all directions during war time.

## A High-Speed Motor Torpedo Boat

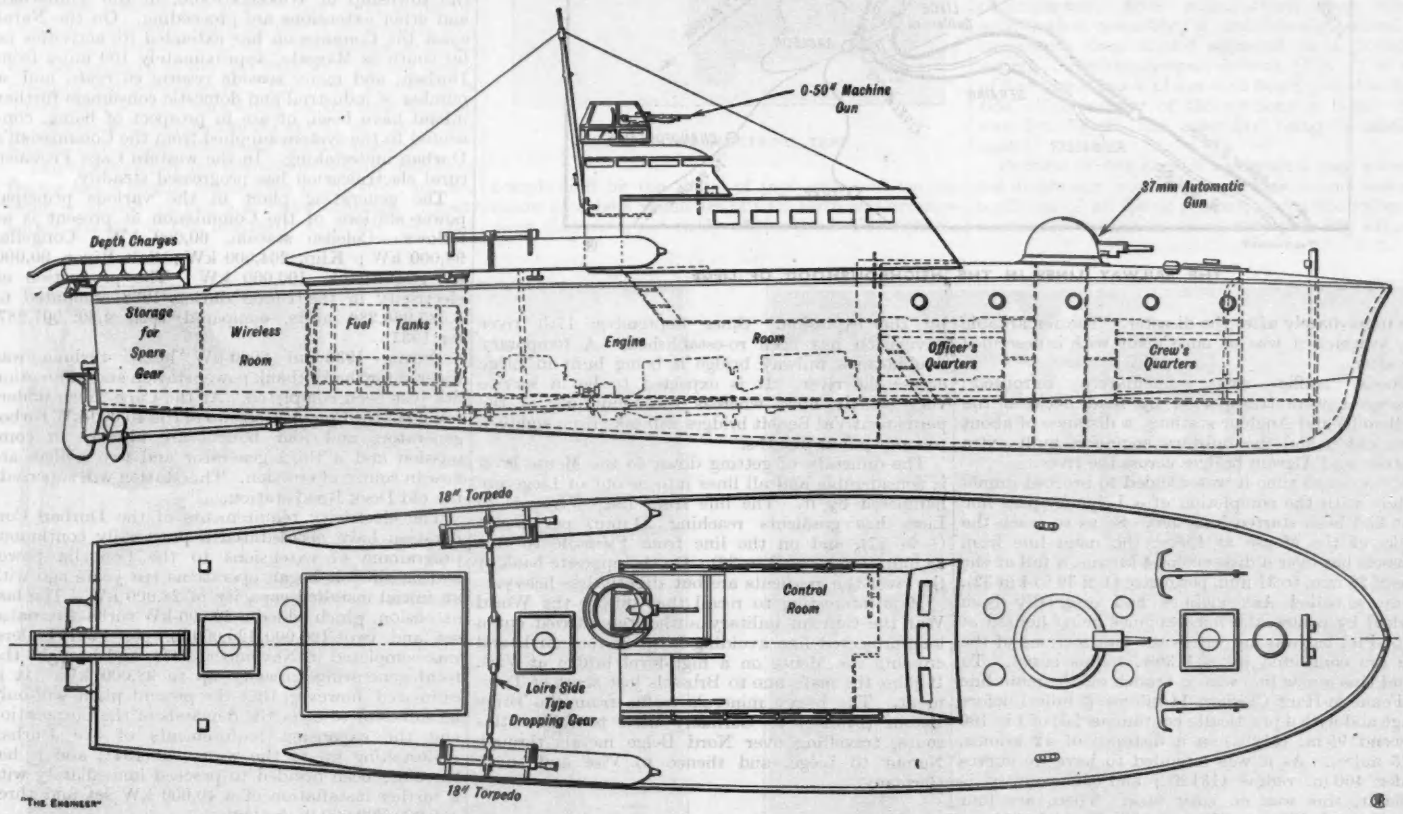
IN our issue of August 4th we described and illustrated a new type of fast motor torpedo boat which has been developed by Aero-Marine Engines, Ltd., of Pall Mall House, 28, Pall Mall, London, S.W.1, Minerva Shipyard, East Cowes, and Paris. This boat, it may be recalled, was demonstrated in the Solent, and on Thursday, July 27th, a speed of 45¼ knots was recorded in trials made under Admiralty conditions over the measured mile in Stokes Bay. In the accompanying drawing we now show the general arrangement of the hull and machinery and the armament. The principal particulars, we may recall, are as follows:—

| | |
|---|---|
| Length ... ... ... ... ... ... ... ... | 20·00 m. |
| Beam ... ... ... ... ... ... ... ... ... | 4·52 m. |
| Moulded depth amidships ... ... ... | 2·43 m. |
| Draught ... ... ... ... ... ... ... | 1·2 m. |
| Average displacement ... ... ... ... | 30 tons |
| Engines—main: Four twelve-cylinder Aero-Marine Lorraine, 600/690 S.H.P. | |
| Engines—auxiliary: Two eight-cylinder Lycoming 100 S.H.P. | |
| Maximum speed on four main engines ... | Over 45 knots |
| Radius of action on four main engines ... | 176 sea miles |
| Cruising speed on two main engines ... | 27 knots |
| Radius of action on two main engines ... | 325 sea miles |
| Cruising speed on two auxiliary engines | 10 knots |
| Radius of action on two auxiliary engines | 650 sea miles |
| Crew ... ... ... ...Six: two officers and four seamen | |

As our drawing clearly shows, the armament comprises two 18in. or 21in. torpedoes, which are housed on deck and are complete with "Loire" type side-dropping gear. The gun equipment comprises one automatic 37 mm. calibre gun mounted in a turret forward, and one 0·50in. calibre machine gun mounted in a raised position above the control room. Some 2000 rounds of the larger calibre and 5000 rounds of the smaller calibre ammunition are carried. At the rear of the vessel there is a rack for holding and dropping depth charges, and six 50 kilo. depth charges are carried.

In addition, a smoke screen equipment is also included. Extremely comfortable quarters are provided for the officers and the crew, the two officers sharing the cabin just forward of the engine-room. Across the passageway from the officers' cabin is the galley, and forward are the quarters for the crew, with provision for four men. Two additional crew can be accommodated in the very commodious wireless sound-proof room, arranged immediately aft of the fuel tank compartment. Access by companion-way from the passage outside the officers' cabin to the wheel house is provided. The T.S.F. wireless installation, which is housed in the wireless compartment previously referred to, is of the latest pattern, embodying short and long wave transmission and reception. The direction-finding fixed aerial is mounted immediately above the wireless compartment on deck, in close proximity to the lead-in insulators, which are, in turn, attached to the aerial to which is attached the collapsible mast.

The demonstration trials of this boat, which we were privileged to attend, showed her to be a very seaworthy craft, and her acceleration, manœuvrability,




HIGH SPEED MOTOR-TORPEDO BOAT

and speed compared well with similar craft. Her steadiness on a course should permit of accurate aim when discharging her torpedoes, while the general absence of vibration and noise from her propelling machinery should conduce to the comfort of her crew whether operating at normal or maximum speeds.

## A New Liege By-Pass Line

ON August 31st, a violent thunderstorm caused the explosives that had been placed in the Liège "Val Benoît" bridge to blow up with dire results. Besides nineteen killed, a number of wounded and the destruction of countless houses within a large radius, the main Brussels-Liège-Verviers-German frontier railway was cut just beyond the Liège Guillemins Station. The Val Benoît double bridge had two tracks on each bridge. Each of the bridges consisted of two side 65-m. and one central 80-m. spans on the Vierendeel system. The destruction was complete and the spans fell into the river, blocking the channel and thus preventing connection between such large factories as the Cockerill and Ougrée Works and the new Albert Canal, which had just been opened. Also, connection with the army at the frontier had to be effected by a roundabout route. Such was the situation immediately after the disaster. The remarkable way in which it was at once dealt with is described hereafter.

Goods traffic was immediately re-routed; passengers were transported by road between the Guillemins and Angleur stations, a distance of about three miles, and the military engineers built extra pontoon and Algrain bridges across the river.

At the same time it was decided to proceed immediately with the completion of a Liège by-pass line that had been started long ago. So as to reach the banks of the Meuse at Liège, the main line from Brussels has over a distance of 4 kiloms. a fall at the rate of 28 mm. to 31 mm. per metre (1 in 36 to 1 in 32). These so-called Ans inclines had originally been worked by cables, the fixed engines being housed at Haut-Pré, halfway up where the two sections of the line are connected by a 1130ft. radius curve. To avoid this a new line was to branch off the main line at Fexhe-le-Haut Clocher, 14 kiloms. (9 miles) before Liège and with a practically continuous fall of 1 in 100 descend 95 m. (312ft.) in a distance of 12 kiloms. (7·5 miles). As it was intended to have no curves under 400 m. radius (1312ft.) and the country is difficult, this was no easy task. There are four tunnels, of 720 m., 376 m., 132 m., and 361 m., totalling roughly 1 mile, the Horloz viaduct, 22 m. high and a 750-m. bridge over the Meuse and its approaches. This work also enables the line to cross both the Nord Belge railways on either bank of the river and to reach the Kimkempois Station yards, whence a spur takes it on to the original Brussels-Liège-Cologne line, which it joins at Angleur, 4 kiloms. beyond Liège.

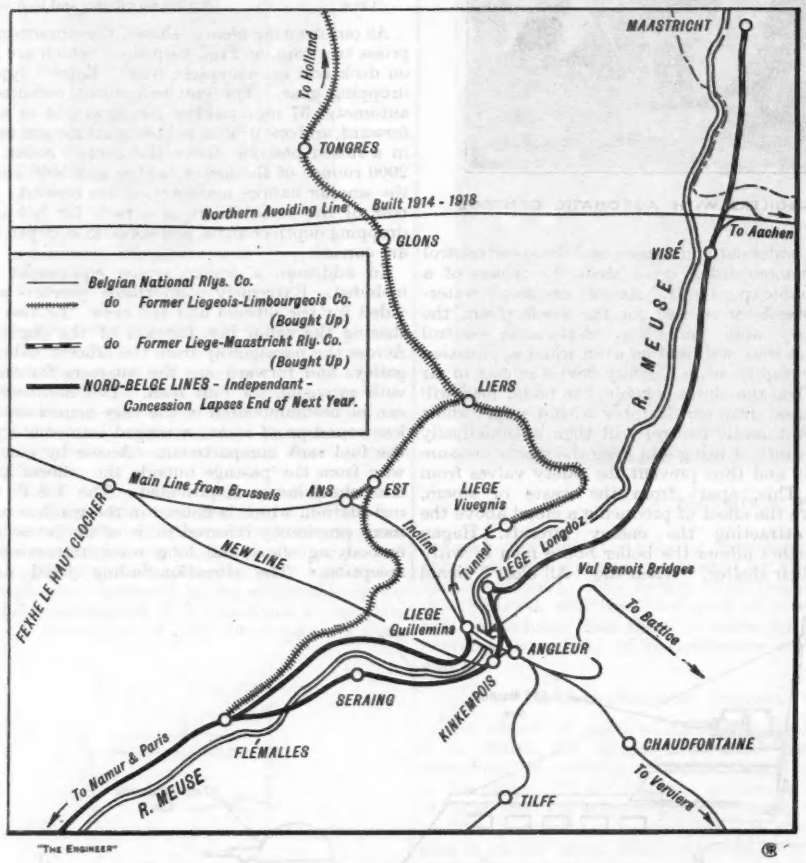
Work had been carried on until July, 1933, and the greater part of the formation and civil engineering works had been all but completed. But the slump having set in and the Albert Canal, which would divert the greater part of the Liège district goods and minerals traffic from the railway, being proceeded with, it was decided to cease work and give up the line, which became derelict.

The blowing up of the Val Benoît bridges obliged the railway authorities to revise their previous decision and on September 2nd, less than forty-eight hours afterwards, work was undertaken so as to complete the railway. It has been carried on by 2100 workmen and engineers, for, besides the finishing touches and rebuilding such portions as had deteriorated, the entire superstructure and signalling had to be carried out. A total of 2500 tons of rails, 40,000 sleepers, 15,000 cubic metres of ballast, carried in 2200 wagon loads, were used and put into the track, the entire work having been completed in twelve days—a most noteworthy performance. Goods traffic started immediately, with a speed limit of 20 kiloms. per hour (12·5 miles); two days afterwards the speed limit was raised to 40 kiloms. per hour (25 m.p.h.), and four days later, with the running of passenger trains, to 70 kiloms. per hour (44 m.p.h.). The total cost reached 165 millions of Belgian francs.

This will give time for repairing the damage done by the explosion. Since September 17th river navigation has been re-established. A temporary double-track railway bridge is being built in Liège across the river. It is expected to be in service very shortly now, whereas the rebuilding of the permanent Val Benoît bridges will take from eighteen to twenty-four months.

The difficulty of getting down to the Meuse level is considerable and all lines into or out of Liège are hampered by it. The line from Liège-Vivegnis to Liers has gradients reaching 34 mm. per metre (1 in 27), and on the line from Flémalle to Ans 28 mm. per metre (1 in 36). On the opposite bank of the river the gradients are but slightly less heavy.

It is interesting to recall that during the World War the German military authorities carried out a long-projected line avoiding Liège in the north and crossing the Meuse on a high-level bridge at Visé. It joins the main line to Brussels just short of Tirlemont. The heavy minerals traffic from the Briey Bassin (France) to Germany used to follow this route, travelling over Nord Belge metals through Namur to Liège, and thence to Visé and so to Germany.




THE RAILWAY LINES IN THE NEIGHBOURHOOD OF LIEGE

ACCIDENTS ON AMERICAN RAILWAYS.—A bulletin of the United States Interstate Commerce Commission's Bureau of Statistics shows that during 1938 there were 4499 persons killed and 27,253 injured in railway accidents of all kinds in that country. Two hundred and ninety-three persons were killed in 5682 train accidents, and of these 52 were passengers. At level crossings, 1517 persons were killed and 4018 injured during the year.

## South African Electricity Supply

THE total output of electricity from the Electricity Supply Commission's six generating stations in the Union of South Africa during the year 1938 established a new record of 3,175,434,133 units, which represents an increase of 15·4 per cent. over the output for 1937. The generating plant capacity of the stations was increased by 103,387 kW in 1938, and the total plant capacity installed or on order at the end of the year was 782,230 kW. An important development during the year was the Commission's decision to establish a new power station to be known as the Vaal generating station undertaking, with an initial installation of 108,000 kW of generating plant, estimated to cost £2,039,000. This station, which will be situated on the Orange Free State side of the Vaal River near Vereeniging, will feed into the grid system of the Commission and the Victoria Falls and Transvaal Power Company, Ltd. Work has been started on the site and the plant is to be ready for operation in 1941 to meet the estimated expansion requirements of the gold mining and other industries.

The Commission's loan capital, which at December 31st, 1938, totalled £16,250,000, was increased in April, 1939, to £18,250,000 by the issue of £2,000,000 local registered stock bearing interest at 3¼ per cent. per annum, at an issue price of £98 10s. per cent. All classes of consumers showed substantial increases compared with the consumption in 1937. Despite the great development of electric traction, the railways' consumption of current remains far less than that of the mining industry. This latter accounted last year for over 70 per cent. of the Commission's output, compared with less than 10 per cent. consumed by the railways and 8 per cent. by the munipalities which are supplied in bulk. The total consumption of electricity on the Reef by the gold mining and other industries and municipalities, &c., exceeded 4,400,000,000 units in 1938, and more than 52 per cent. was supplied from the Commission's power stations at Klip and Witbank, the balance being supplied from power stations owned by the Victoria Falls and Transvaal Power Company, Ltd., three mining companies, and the Johannesburg municipality. South Africa has now nearly 600 route miles of electrified railway lines, compared with well under 300 miles in Australia and India, the only other parts of the Empire, excluding Britain, to have large electrified railway systems.

Practically all the towns, villages, and groups of firms within economic reach of the sub-stations along the route of the electrified railways in Natal and the Orange Free State are being supplied with electricity by the Commission. In Natal the railway electrification has been completed to the border town of Volksrust and development of rural supplies from the Natal Central undertaking has been extended to the township of Wakkerstroom, in the Transvaal, and other extensions are proceeding. On the Natal coast the Commission has extended its activities as far south as Margate, approximately 100 miles from Durban, and many seaside resorts *en route*, and a number of industrial and domestic consumers further inland have been, or are in prospect of being, connected to the system supplied from the Commission's Durban undertaking. In the western Cape Province rural electrification has progressed steadily.

The generating plant in the various principal power stations of the Commission at present is as follows:—Colenso station, 60,000 kW; Congella, 98,000 kW; Klip, 264,000 kW; Salt River, 90,000 kW; Witbank, 100,000 kW The production of electricity in the Union during 1938 amounted to 5,335,966,280 units, compared with 4,602,907,287 for 1937.

During 1938 an 8000-kW house turbine was ordered for the Witbank power station and its erection has just been completed. At the Cape Town undertaking of the Commission two of the 40,000-kW turbo-generators and four boilers are already in commission and a third generator and two boilers are now in course of erection. This station will supersede the old Dock Road station.

The electricity requirements of the Durban Corporation have necessitated a practically continuous programme of extensions to the Congella power station since it began operations ten years ago with an initial installed capacity of 24,000 kW. The last extension, which added a 30,000-kW turbo-alternator set and two 100,000/120,000 lb. per hour boilers, was completed in November, 1938, and brought the total generating capacity up to 98,000 kW. It is estimated, however, that the present plant will only be sufficient to meet the demands of the Corporation and the expansion requirements of the Durban undertaking up to the winter of 1941, and it has therefore been decided to proceed immediately with a further installation of a 40,000 kW set and three 160,000/200,000 lb. boilers.

Eight of the twelve 33,000-kW generating sets to be installed in the Klip power station were in operation at the end of December, 1938, and three of the four 7000-kW house sets were running at that date. The ninth 33,000-kW machine was placed in commercial service on February 8th, 1939. No. 10 is now ready for service and No. 11 was to be ready last month and No. 12, the last, will be ready in February, 1940. Construction of the new Vaal

generating station, which will have an initial capacity of 108,000 kW, capable of increase to 400,000 kW, and which will form another link in the chain of stations supplying the Witwatersrand gold mines, towns, and industries, was inaugurated on March 23rd last. It will be operated by the Supply Commission and the Victoria Falls and Transvaal Power Company, Ltd., in co-operation. The joint supply system is at present being supplied by six power stations with an installed generating plant capacity of 665,000 kW. The capacity is being increased by plant in course of installation or on order for the Commission's Klip and Witbank power stations, which will bring the total installed capacity up to 812,000 kW in 1940.

The site of the Vaal station is on the farm Bankfontein, in the Heilbron district of the Orange Free State, and is ideally situated for the economic generation of electricity. A plentiful supply of coal is available on the farms adjoining. A special feature of the station will be two hyperbolic cooling towers, 320ft. high. Each tower is designed to deal with 4,000,000 gallons of water per hour. The initial expenditure on the station is estimated to be £2,039,000.

The total revenue of the Supply Commission's undertakings in 1938 was £2,232,022, compared with £1,930,719 in 1937. The production costs were £2,218,696, this including interest, redemption, and reserve fund charges. The excess of revenue over production was £13,326; average price per unit sold, 0·176d.; average revenue per unit sold (including sundry revenue), 0·179d.; average cost per unit sold, 0·178d.; coal consumed, 2,630,740 tons (2000 lb. each); cost of coal consumed, including cartage, £789,805; railage on coal consumed accounted for £362,473.

## A Portable Power Unit

A COMPACT portable power unit, comprising a combined geared turbine and condensing plant, has been designed by Richardsons, Westgarth and Co., Ltd., for use in the event of plant breakdowns. It is particularly intended for use by large undertakings, which have a number of power or pumping stations situated at different points in a widely spread area. The design is such that, if damage occurs to the main machinery at one part, several of these small units can be moved to the site to carry on the service without delay, while the main plant is under repair. The unit, which is illustrated in the accompanying engravings, is capable of developing 350 B.H.P. at the gear coupling and its weight, with accessories, is under seven tons.

The turbine is of the two-stage impulse type and forms a small compact unit, which is readily detachable from the rest of the plant. The main governor, overspeed governor, main oil pump, stop valve, &c., are all incorporated as parts of the turbine, and this can be designed to operate with any normal steam pressure and temperature. The plant illustrated is one of three recently completed, having been designed to operate with dry saturated steam at 150 lb. per square inch gauge exhausting to 27in. vacuum.

The turbine shaft and impulse wheels are machined from a single forging made from nickel steel, and the rotor is carried on ball and roller bearings. Steam sealed glands of the labyrinth type are provided where the shaft passes through the turbine casing. This is made of cast iron with the exception of the front quarter which is cast steel where the live steam is admitted. The steam admission valves are of the double beat type controlled by oil pressure varied by the main turbine governor according to prevailing load conditions.

The reduction gear gives a final shaft speed of 1500 r.p.m. and is of the single helical type with a thrust balancing device. The pinion is made from nickel chrome molybdenum steel, while the wheel ring is of nickel steel. The lower part of the gear casing is cast integral with the main bedplate, which also incorporates the oil tank and condenser body. This latter contains just over 270 square feet of cooling surface formed by ⅝in. diameter brass tubes fixed in the gun-metal tubeplates by means of screwed ferrules, the tube arrangement being such that the exhausted steam has easy access to the tube banks.

The condensor is also provided with a vertical atmospheric relief valve. Circulating water and condensate are dealt with by means of two pumps mounted vertically on one shaft and driven by means of gearing from the slow speed shaft of the reduction gear, the complete pumping unit being housed within the base of the cast iron bedplate.

The air ejector, which forms a separate unit, is mounted on the condenser. It is of the two-stage steam operated type, in which the steam is condensed in a small surface condenser, taking its cooling water from the main condenser condensate extraction pump discharge branch. A complete oil system is incorporated in the set, and this includes the main oil pump, duplex oil strainer, and oil cooler. A steam separator and drain traps are also included in the set, which forms a compact power-bloc unit, with all auxiliaries and fittings ready for connecting up to existing sources of steam and water, and to the main pump or electrical generator which is to be driven.

## Thermostatic Steam Traps

THE control and circulation of steam for process steam uses, or specifically, in the approximate range of pressure from 5 to 125 lb. per square inch, is often

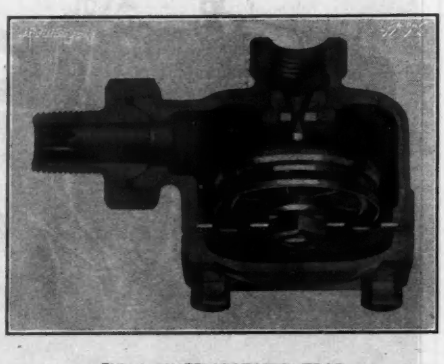


FIG. 1—THERMOSTATIC TRAP

complicated by the shape of pipe coils and various steam chambers which are of such form and arrangement that air is not easily discharged. The elimination of all air, both that entrained with the steam and that present in the form of pockets, in steam using equipment is essential to ensure the maximum heat output and highest efficiency from the machine. When the system is put under steam it becomes necessary to discharge this air through the steam traps or their by-passes before heating coils and chambers can be brought to the point of maximum

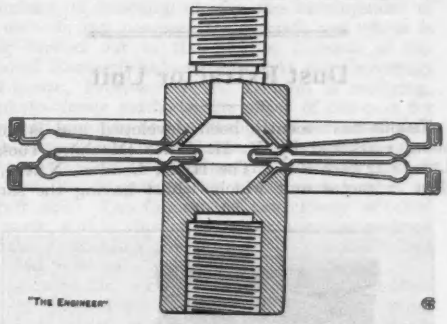



FIG. 2—DIAPHRAGM ELEMENT

heat output. In the "78" and "79" series of thermostatic traps (Fig. 1) manufactured by Warren Webster and Co., Ltd., Commerce Way, Purley Way, Croydon, it is claimed that monel metal thermostatic elements are so calibrated as to give a complete compensation for pressure throughout the operating range and consequently that elimination of both free and entrained air from steam using apparatus is

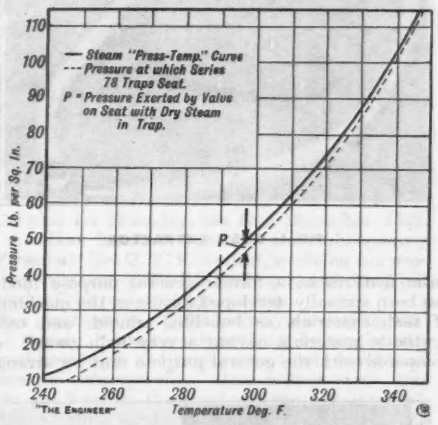
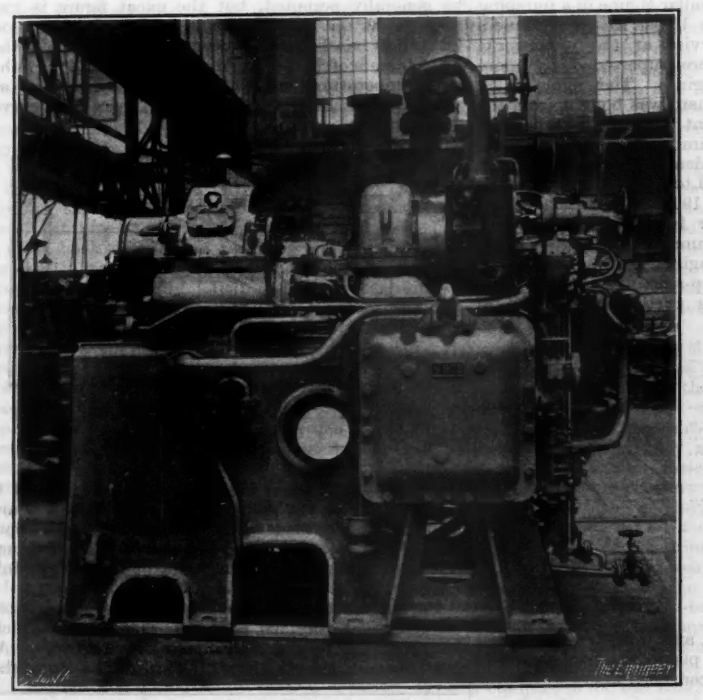
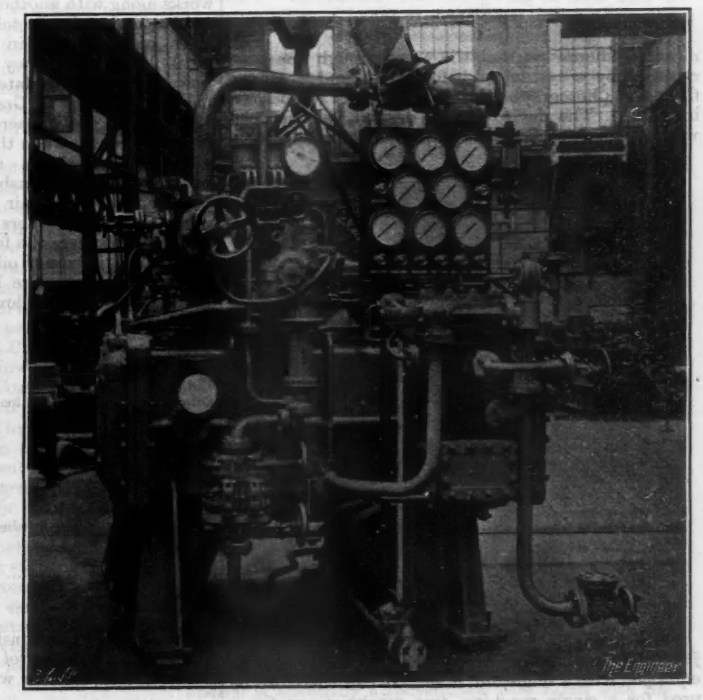



FIG. 3—OPERATION OF TRAP

accomplished. After manufacture, each element with valve assembly is individually tested and calibrated, then finally adjusted to a permanent setting. The diaphragm element (Fig. 2) is made of four monel metal plates with heavy radial stiffening ribs. The interior of the element is filled with a sensitive liquid, the assembly being hermatically sealed.

Because of the correct calibration and setting of the diaphragm, contraction of the element under the condition of air being present, opens the valve, and conversely expansion, when only pure dry saturated




350 H.P. PORTABLE TURBINE AND CONDENSER UNIT

steam is present, closes the valve. Both these operations come into effect under their respective conditions, within the recommended operating range of the trap, regardless of the actual pressure and temperature values prevailing. In Fig. 3 is illustrated the operation of the trap in relation to the steam pressure-temperature curve. A distance such as "P" records the pressure exerted by the valve on its seat with dry steam in the trap.

## Dust Extractor Unit

THERE has recently been developed and is now being marketed by E. H. Jones (Machine Tools), Ltd., Edgware Road, The Hyde, London, N.W.9, a dust extractor unit which, whilst having the same

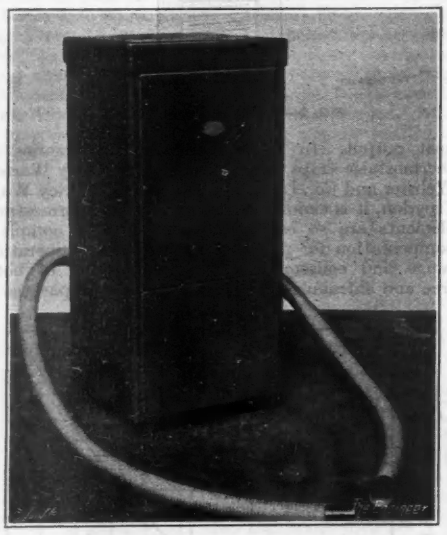


FIG. 1—DUST EXTRACTOR

basic features as a former general purpose model, has been specially developed for use in the machining of such materials as bakelite, erinoid, and other synthetic materials having a very light swarf. As compared with the general purpose unit its arrange-

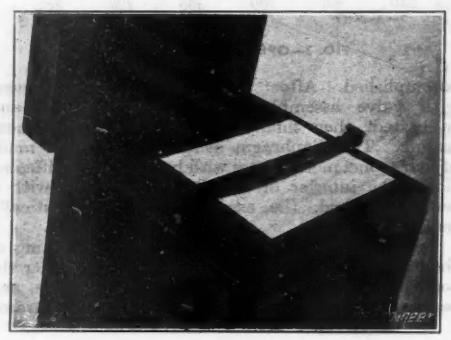


FIG. 2—CANVAS FILTER

ment is different in that the water trough has been replaced by a system of baffle plates and a canvas filter. A photograph of the new unit is reproduced in Fig. 1. The device can, if desired, be equipped with two 2in. suction pipes connected up by a special

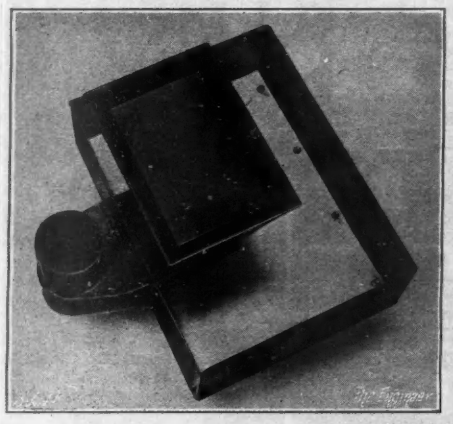


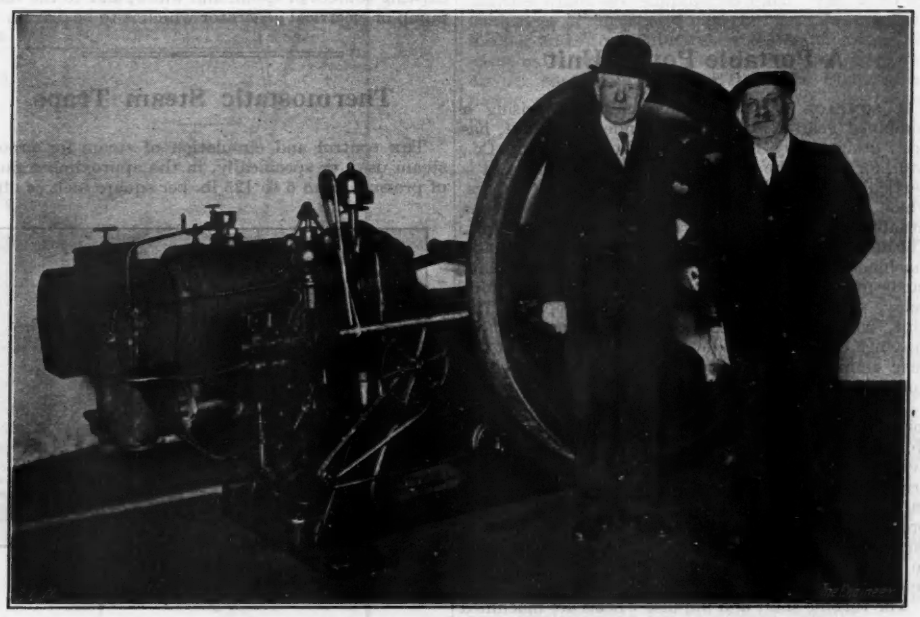
FIG. 3—BAFFLE PLATES

junction box. Alternatively, the machine can be equipped with a single 3in. hose. It can therefore be used for a single machine, two machines, or for a double ended machine.

Operation and cleaning of the unit is simple. A powerful fan with a self-contained electric motor draws air through a system of six baffle plates. After passing through these baffle plates, most of the dust is deposited into the container. The finer dusts are then removed as the air passes out through a double or triple canvas filter. The canvas filter can be seen in Fig. 2, which is a view of the top of the unit with the lid open and the system of baffle plates underneath the canvas filters is clearly shown in Fig. 3, which illustrates the top section of the unit removed. For use with very fine "floury" dusts a special dust collection bag can be used in place of the baffle plates and the canvas filter. Cleaning the dust container is accomplished by removing the two wing nuts which hold down the cross bar above the filter unit as seen in Fig. 2 so that the top of the unit can be removed. The dust container is then withdrawn through the front of the unit. The complete unit can easily be moved about the shop as it is mounted on four swivelling casters. The motor is accessible for greasing by removing the front plate seen at the lower front part of the cabinet.

## A Veteran Oil Engine

THE first commercially produced oil engine sent out from the Grantham Works of Ruston and Hornsby, Ltd., has returned to its birthplace. This engine was delivered in May, 1892, and was built from the patents of Herbert Akroyd-Stuart. The two men shown in the engraving herewith assisted in the manufacture of the engine and are still in the makers' employ. It was erected at Fenny Stratford Waterworks along with another similar engine in a pumping station under the Bletchley Urban District Council. Both engines were in service at the waterworks until 1923 when they were superseded by more powerful and up-to-date engines. The engine which has just returned to Grantham was bought from the U.D.C. by a timber merchant in Bletchley, who used it until recently when the timber business was closed down. This engine, incidentally, was borrowed by Ruston and Hornsby, Ltd., to be shown at the British Industries Fair in 1930, after which it was returned to its owners for further service. These early engines were the forerunners of the present day mechanical injection oil engine. Although running on paraffin they were lamp-starting, solid-injection engines, and the following particulars may be of interest:—



AKROYD-STUART PARAFFIN ENGINE OF 1892

| | |
|---|---|
| Maximum Load | 9½ B.H.P. |
| Speed | 200 R.P.M. |
| Indicated H.P. | 12‡ |
| Oil per B.H.P. maximum load | 1·4 pints. |
| Hours run on test | 140 |
| Bore | 11in. |
| Stroke | 15in. |
| Crankshaft diameter | 3½in. |
| Crankshaft pin diameter | 3½in. |
| Ref. Mean Pressure | 25·7 |
| Mechanical Efficiency | 75·5 |
| Weight of Engine less flywheel | 1 ton 8 cwt. 3 qrs. 0 lbs. |
| Weight of flywheel | — 13 „ 0 „ 0 „ |
| Total | 2 „ 1 „ 3 „ 0 „ |
| Weight per B.H.P. | 505 lb. |

The original liner, piston, and piston rings are still in the engine. One set of piston rings was ordered in 1911, but the order was cancelled later.

## Marine Superheaters*

HITHERTO, we have considered the case of a superheater exposed to gases which at service power have a temperature of about 1200 deg. Fah., and it seems that provided adequate circulation of steam is secured, no difficulties need be anticipated. It is next necessary to consider conditions when boiler is under partial load, and this will be done in some detail as, in the Author's view, the partial load condition is the one that often demands most attention in the interest of the superheater. At lower loads the temperature of the gases to which the superheater is exposed, falls as shown in Fig. 1. The one curve relates to Scotch boilers, and the other to water-tube boilers. For the purpose of this paper the curves show a mean of the temperature with coal and oil burning, the temperature with the first fuel being rather higher, and those with the second rather lower. At low boiler loads there is a vital difference between solid coal and oil burning, in that with the former fuel all furnaces, in the Scotch boiler, are able to share the load equally, right down to the banked-fire condition; similarly, with the mechanical stoker all portions of the grate can share the combustion down to very low loads. In the case of oil burning, however, at a certain proportion of the full boiler load, it is necessary to shut off a proportion of the burners, and as the load gets lower more burners have to be shut off, till at the banked-fire condition we have a single burner in use "off and on."

For the purpose of this paper let it be assumed that at 40 per cent. of full output it becomes advisable to shut off burners; this figure of 40 per cent. may not be generally accepted, but the exact figure is immaterial at the moment. For further simplification let us now consider the boiler in question to be of the 3 furnace Scotch type, and in Fig. 2 are shown the gas temperatures existing at the superheater at various loads below 60 per cent. There is a curve

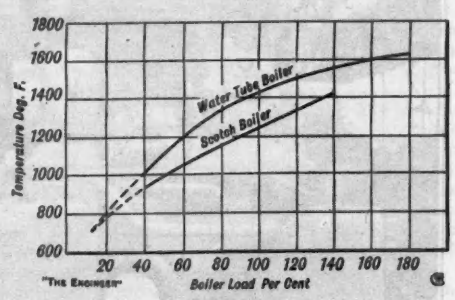



FIG. 1

for each of the three furnaces, called A, B, and C respectively, and it will be noted that B and C are shut off at boiler loads of 40 per cent. and 27 per cent. respectively—that is, when the load on the individual furnaces has fallen to 40 per cent. of the furnace full load.

Particular attention is required to superheater conditions at, say, 20 per cent. boiler load, which load is carried by a single furnace, namely, furnace A. The evaporation of the boiler, and therefore the

* From a paper read before the N.E.C. Inst. by Mr. Harry Hunter, Dec. 15th.

quantity of steam passing through the superheater, is only 20 per cent. of the full quantity, but the one furnace alight, A, is at a combustion load of 60 per cent. If there are no superheater elements in A, or if such elements as may be in A are suitably "remote," then all is well; if, however, elements in A are "business" elements, then from their point of view, although exposed to 60 per cent. of full combustion, they have at the best only about 20 per cent. of full steam circulation. These conditions will result in

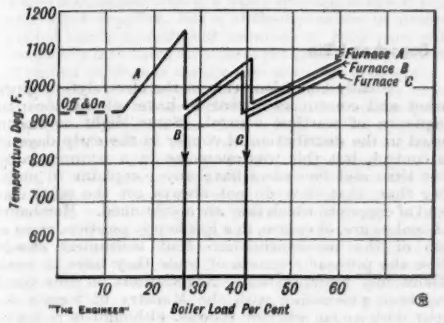



FIG. 2

steam and metal temperatures of the order of 1000 deg. Fah., and deterioration is to be expected.

Clearly then the designer, to meet partial load conditions, must arrange one furnace without superheater elements, or with elements suitably remote, and the operator must let that furnace carry the first part of the load, thereby ensuring adequate circulation through the "business" superheater elements before their furnaces are lighted.

## Sixty Years Ago

### CARGO STEAMERS

IN our issue of December 19th, 1879, we drew attention to the frequent disappearance with all hands of cargo steamers, and especially of steamers carrying grain in bulk. The world at large, we said, heard nothing of the loss of ships which did not carry passengers, but if all the facts concerning the construction and working of cargo steamers were made known, there would be an insistent demand for a drastic change. As a rule, cargo steamers were very bad sea-boats. They were long, narrow, deep in the waist and wall sided. For the most part they were well built. We had never heard of one breaking in two. They did not leak, for leaky ships ruined their cargoes. Their defects were not in workmanship or material, but in shape. They were designed simply to have the largest possible carrying capacity, and were narrow, flat-sided, flat-bottomed iron boxes instead of ships. They were craft which would not steer well, which could not sail, which could not ride safely head to sea, or run before a gale. In addition they were "awful rollers." The old-fashioned sailing ship was infinitely more seaworthy than the modern iron steamer. The builders were not to blame. They supplied what the owners asked for. The owners secured themselves by insuring heavily, and the insurance was divided among so many underwriters, that no individual retained sufficient interest in the matter to make him insist that craft possessing some of the qualities of a real ship should be sent into the Atlantic or the Bay of Biscay in winter. The risks inherent in the system of constructing cargo ships were doubled, and trebled by the manner in which they were loaded. When a ship carrying grain in bulk began to roll, her cargo frequently set the "shifting boards" adrift. We reported an instance of a grain ship in which the cargo shifted during a moderate gale. By great exertions the captain hoisted sail and steered a course that lifted the depressed side up and shifted the grain back again, thus restoring the ship to an even keel. Such an expedient could not often be repeated successfully. In numerous cases, ships foundered by rolling heavily and shifting their cargoes. When that occurred they could not recover themselves, a couple of green seas would break on board and lodge in the waist. Then one plunge and all would be over. A movement was on foot, we recorded, which would result in grain being carried in sacks instead of loose. Such a course would do something to alleviate the situation, but it would not overcome the prime fact that cargo ships as commonly constructed were dangerous "floating coffins." Many causes were in action leading to that result; the system of underwriting; the mode of measuring cargo space; the demand for quick loading and discharging facilities; the manner of levying dues; the demands of the Board of Trade; and the necessity of arranging the holds and hatches in such a way that any kind of cargo from a couple of thousand tons of railway iron to an assortment of china and threshing machines could be carried below. It would require something more than a decision to carry grain in sacks instead of in bulk to ensure that valuable lives, to say nothing of much property, would not be thrown away.

## Aeronautical Research in Canada

WITHOUT shouting to the world of the beneficial strides that are being made in the field of aeronautics at the National Research Laboratories at Ottawa, a committee that was formed nearly twenty years ago is going systematically and methodically about its work under the able chairmanship of Air Commodore E. W. Stedman, Chief Aeronautical Engineer of the Department of National Defence.

The Associate Committee on Aeronautical Research was organised in 1919 by the Honorary Advisory Council for Scientific and Industrial Research at the request of the Air Board. The Committee's function was to foster aeronautical research in Canada and supply technical assistance to the Air Board in the problems with which it was faced. The Committee's current expenses were provided by the Advisory Council, and the expenses involved in special research undertaken by the Committee were met by grants from the Advisory Council or from the Air Board.

The first meeting of the Committee was held on February 7th, 1920. At this meeting the more pressing problems were reviewed and steps were taken to obtain information as to the experimental work already accomplished or in progress in England, France, and the United States in order that duplication might be avoided. The possibility of new problems arising peculiar to aviation in Canada was considered and the aircraft industry was notified of the formation and objects of the Committee, and suggestions were invited as to the lines of work which would be most helpful to industry. The research facilities existing in the Dominion were carefully investigated, and the Committee became acquainted with the men who were available to work in the field of aeronautical research.

In the years that followed the Committee was able to make financial grants to assist aeronautical researches carried on in various parts of the Dominion. The facilities of the University of Toronto wind tunnel were extremely valuable, both to the Committee and the industry, as likewise were the facilities at McGill University and the University of Alberta.

Some of the more important investigations initiated by the Committee include the winter operations of aero engines, with special reference to starting conditions, work which covered a study of the running conditions, lubrication, cooling, &c., of aero engines at low temperatures. The starting and early running technique developed from this work was made a routine in the flying service for a number of years. The effect of low temperature on lubricating oils and on the strength of such materials as spruce, plywood, streamline wire, and rubber shock cord, was investigated at the Committee's suggestion. In the development of a controllable pitch propeller the Committee provided funds for the construction of the experimental propeller and made arrangements for it to be tested at Camp Borden. The propeller was successful and has now been commercially developed. The elimination of magneto noises in the radio-telegraphic receiving equipment used in aircraft and the development of a piezo-electric engine indicator were two other problems, the investigation of which was promoted by the Committee.

The Committee now forms a *liaison* between the aircraft manufacturers and operators, on the one hand, and the Aeronautical Laboratories of the National Research Council on the other, and ensures that the aeronautical researches now being carried on will have immediate beneficial application to Canadian aviation. Its membership includes representatives from the National Research Council, the Department of National Defence and Transport, the Canadian Air Transport and Manufacturers' Association, the aircraft engine manufacturers, and the gasoline and oil industry.

At the instigation of the Committee an investigation was undertaken of the strength of aircraft floats. For this work a considerable number of floats discarded by the Royal Canadian Air Force were tested to destruction to find out how their mechanical construction agreed with aircraft design requirements. Some very illuminating results were obtained.

The Committee has been particularly interested in aero-engine operation. A programme of tests is now being carried out by the R.C.A.F. and Canadian Airways, Ltd., on the use of low-viscosity oils for winter operation, and the Committee has had developed an instrument which will show at all times the lubrication conditions in an aircraft engine and will indicate directly when the conditions are safe or unsafe. This instrument will replace the oil pressure and temperature gauges as used at present and will obviate the necessity for charts to correlate their readings with oil viscosity and flow. The Committee is also considering trials of an oil dilution system to facilitate cold-weather starting.

As a direct result of the Committee's efforts the following equipment has been made available for test and research:—X-ray apparatus for the examination of aircraft castings, a small engine dynamometer capable of handling engines of less than 500 H.P., and equipment for the study of vibration in aircraft structures. As regards this last item, the Committee is aware of the growing importance of vibration and has appointed a researcher who will shortly commence a study of the whole question with actual measurements in flight to be taken with the apparatus developed under the Committee.

Aircraft firewalls to isolate the engine compartments and prevent the spread of possible fires are receiving attention, and performance tests are being made on samples of the various types available to both British and United States specifications. The Committee is watching closely the development of the cathode ray compass for aircraft use which is being carried out in the physics division of the National Research Laboratories. At the University of Toronto, Professor T. R. Loudon is studying, by photo-elastic methods, the effect of cut-outs for doors and windows on the strength of a stressed skin fuselage, work which the Committee is sponsoring.

During the last two winters the Research Council has been investigating the snow performance of aircraft skis. The Committee has closely watched this work, and in view of its importance has assisted financially, enabling the work to be continued and amplified in scope.

Concerning the immediate future, the Committee recently pressed for the provision of a spinning tunnel in which scale models of existing aircraft and new types can be freely spun to determine their margins of safety in recovery from spins. The removal of frost from aircraft left standing in the open during severe winter weather is another problem to be studied, which is of importance to Canadian aircraft operators. The possibility of refining some of the vast supplies of Canadian crude oils for aviation use has been reviewed. Inasmuch as this may entail an increase in the lead content of fuels, the Committee is first proposing to investigate the effect of higher lead contents.

## The Institution of Locomotive Engineers

THE Opening General Meeting of the current Session of the Institution of Locomotive Engineers was held at the Waldorf Hotel, Aldwych, W.C.2, at 2.30 p.m. on Thursday, the 14th December, 1939. The members lunched together, and subsequently the President, Mr. O. V. S. Bulleid, spoke on the war-time organisation of British Railways, and described the work of the principal committees.

"The organisation of the railway services in war-time," he said, "was considered long before the outbreak of hostilities, and preparation made to meet all foreseeable contingencies. The rolling stock was kept in good repair, the tracks properly maintained, and stores accumulated within reasonable limits by the Companies themselves. The lessons of the last war were remembered and preliminary arrangements made for the control of the railways in war-time."

In his conclusion he said, "We Locomotive Engineers know that a prosperous railway industry—one of the greatest of the country—means prosperity to many towns and trades and to the 600,000 people directly employed by it. It is no exaggeration to say that the country cannot be prosperous if the railways are not. The services rendered to the country in peace time are great: the assistance given would have been greater in both men and material but for the economies imposed on the Companies in peace time by the failure to ensure equitable treatment; we may hope this will not be allowed to occur in the future. The railway staff are giving of their best to ensure efficient transportation and thereby help the State. The terms of compensation to the railway companies for the great railway organisation system taken over are now under discussion, and we have no doubt but that they will be generous."

NEW OIL FIELD AT BAKU.—The Azov Oil Prospecting Trust is reported to have completed preparations for the industrial exploitation of a large new petroliferous area in Siazan-Nardaran, situated 62 miles north-west of Baku. The new oil deposit comprises a narrow strip of land, 3½ miles long, where, in the course of the next three years, it is intended to sink 250 wells for industrial exploitation. So far six experimental wells have been sunk. Four of them have been tested and have yielded oil, their aggregate output amounting to 60 tons of pure oil per day. An oil pipe-line will be laid from the new field to connect up with a new railway being built in the district of Siazan-Nardaran.

A NEW CORE BARREL.—The conventional method of coring productive oil formations brings a specimen of the reservoir rock to the surface of the ground, but during the process the pressure in the core is reduced to the atmospheric level and the gas associated with the oil in the core expands and escapes. The expansion of the gas also drives part of the oil from the core. This loss of oil and gas from core specimens has greatly handicapped engineers in accurately estimating the fluid content of petroleum reservoirs. A pressure core barrel that cuts a core of the producing formation in an oil well and seals the core in an inner barrel while it is still at the bottom of the hole, has been developed by the Bureau of Mines, United States Department of the Interior, in co-operation with the American Petroleum Institute. The new barrel is essentially a conventional core barrel with the addition of special valves at either end of an inner barrel and a mechanism for closing the valves while the barrel is at the bottom of the hole.

# Markets, Notes and News

**The prices quoted herein relate to bulk quantities. Unless otherwise specified home trade quotations are delivered f.o.t. Export quotations are f.o.b. steamer.**

### Import Licences for Iron and Steel

A Board of Trade Order entitled "The Import of Goods (Prohibition) (No. 10) Order, 1939," came into force on Monday, December 18th. This Order adds to the list of the goods requiring an import licence iron and manganese ores, all the principal forms of iron and steel, and certain materials used in the manufacture of iron and steel. The intention of the Order is to facilitate the purchase and transport of all necessary supplies of these materials, and so far as is practicable importations will pass through normal trade channels. Any goods covered by the Order which have been despatched to Great Britain before the coming into force of this regulation will not require a licence. The licences will be issued by the Import Licensing Department of the Board of Trade on the recommendation of the Iron and Steel Control Department of the Ministry of Supply. For licensing purposes the goods set out in the schedule attached to the Order fall into two broad classes: (*a*) iron and manganese ores, concentrates, and residues; (*b*) all other goods mentioned in the schedule. Importers are advised that in order to expedite the issue of licences, separate applications may be submitted not only for each class of goods, but in respect of each proposed purchase or transaction. The materials included in the schedule comprise iron ore and scrap, certain non-ferrous metalliferous ores and scrap, non-ferrous metals and manufactures, chemical manufactures and products, ferro-alloys, silicon in all forms and silicon alloys, most descriptions of iron and steel and iron and steel products, including railway material, tubes, wire netting, nails, rivets, and screws. It is understood that to a great extent centralised buying will be carried out by the British Iron and Steel Corporation, which is the iron and steelmakers' central buying and selling organisation. The Corporation has in the past purchased large quantities of scrap in America, and of pig iron and semi-finished steel on the Continent. The assurance given in the Order, however, that so far as possible importations will pass through normal trade channels should facilitate the smooth arrangement of purchases.

### The Pig Iron Market

The situation in the pig iron market is fairly satisfactory, and there are few complaints that firms are unable to obtain their supplies, although in some cases consumers are not receiving iron to the analysis they are accustomed to use. It is realised, however, that in war time there must be inconveniences of this description and the Control appears to have been successful in regulating supplies. In certain districts there seems to have been an increase in the number of licences issued to users and from this it is gathered that the stocks at some of the consuming works have been depleted. The policy of the Control recently has been to scrutinise applications for licences in order that there shall be an equitable distribution of pig iron and that firms which have them shall work off reserves. There is still irregularity in operations in the light castings industry and whilst some foundries are well employed they would appear to be those lucky enough to have secured Government contracts. In other cases part-time working is still the rule. On the North-East Coast there is a good demand for pig iron from the foundries, most of which are engaged in producing heavy engineering castings. Supplies of Cleveland foundry iron are difficult to obtain as the production of this was suspended some time before the war began, and the stocks at the producing works have been greatly depleted by subsequent deliveries. The local foundries therefore obtain most of the material required from Midland producers. Some interest was aroused recently by offers of Continental pig iron, but prices were well above those of British material, and no business has been reported. In the Midlands the light castings makers appear to be fairly well off for work, and an increasing number are obtaining Government orders. The buying of pig iron, however, is on a hand to mouth basis when compared to normal trading, but this of course is inevitable whilst the present policy with regard to supplies is in force. The demand for low phosphorus iron is heavy, and supplies are not always easily obtainable, so that in a number of cases consumers have turned to hematite. Rather irregular conditions prevail in the Scottish market, and the foundries which are not employed upon war work are in some cases operating only three days a week. Others who have secured Government contracts are taking up rather good tonnages of pig iron. The position in the hematite market has become somewhat tight, and the producers are showing less disposition to enter into forward contracts. Stocks in the makers' yards are still fairly heavy, but it is stated that they are earmarked against sales which have been made.

### The North-East Coast and Yorkshire

The situation in the iron and steel industry on the North-East Coast shows little change from week to week. The works continue the struggle to meet the increasing pressure of consumers anxious to secure deliveries. As a result of the heavy influx of work, delivery dates are being extended and there is naturally a tendency to fall into arrears in the execution of orders. On the whole, however, the Control is resulting in a fairly even distribution of material of those consumers engaged upon Government work who are most in need of steel. The pressure from the re-rolling trades to secure supplies of billets and sheet bars is heavy, and some of the consuming works report that they are unable to operate to full capacity owing to the stringency in this department. The producers of semis have for months been exerting every effort to increase their output but it remains insufficient to meet the full requirements of the market, and although there has been a distribution of foreign semis it has not been sufficient to bridge the gap between the home production and the demand. It is understood, however, that arrangements have been made which will increase imports and so relieve the position. The pressure to obtain sheet bars has not relaxed as a result of the major portion of the A.R.P. contracts having been completed, since the sheet works are now turning their attention to their home trade orders and to working off the arrears of export contracts on their books when the war commenced. A short time ago permission was given to the sheet-makers to complete one-third of these contracts by December 31st, and this week they have been given authority to complete a further one-third by March 31st. The plate mills are working at full capacity, and the demand shows no signs of slackening, particularly for ship-plates, since all the ship-building yards have full order books. Business in structural steel is only limited by the capacity of the manufacturers to accept fresh orders. A huge tonnage continues to be absorbed by constructional engineering firms, most of whom are engaged upon important Government contracts. In the Yorkshire industry the pressure under which the works are operating shows no signs of declining. The demand for basic and acid billets is increasing, and the works are gradually getting behind with deliveries, notwithstanding that all available plant has been brought into operation. In Sheffield the works are fully employed, and a feature of the position is the large amount of railway material which is now being turned out. The forges and foundries are equally well employed and the tool steel makers have enough work on their books to keep them busy for months. High speed and special steels are also in strong request.

### The Midlands and South Wales

Few complaints are heard in the Midlands of the conditions prevailing in the market under the steel Control. A certain amount of delay in the receipt of material is inevitable whilst the pressure of demand remains so heavy. Interest has been aroused by the removal of the import duties which it is presumed will be followed by an increase in the imports of foreign steel. This should help to ease the position, which has certainly become tight. With practically every engineering firm fully engaged upon Government work and urgently pressing for supplies of steel, the capacity of the works is taxed to the utmost. Large quantities of joists and sections are passing into consumption, and there is equally heavy pressure to secure the smaller sizes of bars and sections which are turned out by the re-rollers. The latter industry is suffering to some extent from the stringency in the billet position and in some instances plant is not being worked to its full extent. Interest is taken in the price situation to a moderate degree, and there seems to be general expectation that there will be a further advance in quotations in the New Year. The Control has succeeded in keeping the home price well below the world price, and it is unlikely that any serious exception would be taken if the authorities decided to permit an advance since practically all consumers are more concerned with obtaining delivery than with the price they pay. The sheet works have now turned to the execution of the export orders which were upon their books at the outbreak of war, although they have not yet entirely finished with the contracts for heavy sheets for A.R.P. requirements. The South Wales steel industry is fully employed principally upon Government contracts, with the result that ordinary business is severely restricted. All the steel works have sufficient orders on their books to keep them employed for several months. The stringency is chiefly noticeable in the production of sheet and tinplate bars, and to some extent this is hindering the output of finished products. The tinplate works, however, are in a good position, and are operating at 72 per cent. to 73 per cent. of capacity. The production of steel ingots for making tinplate bars in Wales during November amounted to 27,856 tons, compared with 30,293 tons in October. A strong export demand is still being experienced, and quotations have risen from 31s. 6d. to 32s. 6d. f.o.b. 20 by 14 basis. The home price, however, remains fixed at 21s. 6d. f.o.t.

### New Non-Ferrous Metals Order

A non-ferrous metals Order advancing the prices of copper, lead, and spelter has been issued and takes effect from December 18th. The Order is entitled "The Control of Non-Ferrous Metals (No. 5) Order, 1939," and brings together in one document, with some amendments, the operative provisions of the four previous Non-Ferrous Metals Orders which are now repealed. The Control points out that the most important feature of the new Order is the new scale of maximum prices fixed for copper, lead, and zinc, and the consequential increase in the maximum prices of certain zinc products and varieties of non-ferrous scrap. These increases are necessitated partly owing to increased costs of freight and other charges, and partly to the fact that the prices now quoted are for delivery at the consumer's premises whereas previously they were mainly on a c.i.f. or ex-warehouse basis. The Order also sets out the circumstances in which the maximum prices may be varied for delivery in small lots, special shapes and sizes, &c., and empowers the Minister by special or general direction to prescribe what these variations shall be. Direction No. 1, which is issued with the Order, fixes a scale of premiums for certain shapes and sizes of copper, and provides for a discount in the case of copper cathodes. The effect of making the official prices "d/d consumer's premises" will be to bring the cost of the raw material equal in all districts. Hitherto firms buying on a c.i.f. or ex-warehouse basis have been obliged to pay carriage, and in some cases the charges to bring the metal to their works have added considerably to the price, whilst other works being nearer to the points of delivery have secured an advantage.

### Copper and Tin

Steady conditions rule in the electrolytic copper market and consumers appear to have settled down to acceptance of wartime control. Some slight confusion existed in the distribution of copper in the early days of the control, but this was overcome in a commendably short time and few users have any complaint to make other than that they do not always get the particular brand of copper to which they are accustomed. Merchants and dealers are, of course, in a less happy position, since in spite of the recommendation that consumers should utilise the pre-war channels of trade they have to work without any remuneration. Negotiations on this point have been proceeding with the Ministry of Supply for weeks, but so far without success, although it is hoped that the proposals for the solution of the problem which have recently been placed before the Ministry will be accepted. In the United States a slightly easier tone has developed and the price appears to have slipped back from 13 cents f.a.s. to 12.90 cents. Comparatively little business, however, has been transacted and it would appear that American consumers have satisfied their requirements for some time to come. There has been a considerable amount of export buying in the United States, and the largest purchasers have been Japan and Italy. Buying by Scandinavian countries is continuing on a routine scale at full prices. The world production of blister copper is not without interest in these days, and the American Bureau of Metal Statistics has issued some figures of output outside the United States. These however are very incomplete since nothing is given for Russia, Japan, Germany, and a few other European countries. From the statistics it would appear that the production is rising since the total for the first quarter of the year is given as 287,700 tons against 301,200 tons in the third quarter. . . . The de-control of the tin market has been followed by active buying and selling, and after a week some idea may be gauged of the way in which the market will probably move. On the first day the price jumped to practically the same level as the American quotation, but from then declined to £260 for cash, and between £256 and £257 for three months. The advance certainly seemed to have the effect of bringing out a fair amount of tin, whilst on the other hand the volume of dealing in cash metal which has been practically the only kind of business transacted on the Exchange declined, and more interest was shown in three months metal. This indicates that consumers are not in great need of tin, and are welcoming the chance of hedging against their sales. The general view is that production at the rate authorised by the International Tin Committee for the first few months should provide more than sufficient tin to meet the world's consumptive wants and that prices will recede. Some support is given to this view by the fact that in the United States prices have shown a tendency to decline in sympathy with the London quotation.

### Lead and Spelter

The control continues to keep consumers well supplied with metal for national purposes, but users requiring lead for work of an ordinary commercial character do not find it easy to obtain the necessary licence. There has been no real interruption to supplies, but freight from the producing countries is not obtainable with regularity, as so many vessels are required for the transport of other materials of equal or greater importance to the national war programme. For this reason, therefore, the control is careful to scrutinise all licences as it needs assurance as to the necessity and urgency of consumers' requirements. Firms having stocks are expected to work on the material in hand in order that supplies may be provided for those without reserves. It must be admitted, however, that this system appears to be working well, and whilst a certain amount of grumbling is only to be expected, most consumers take the view that the position is much better than might have been expected in wartime. The American market continues firm, but as time goes on the efforts of consumers to obtain lead at any price is passing, and steadier conditions should develop. New business has been less active, and it is generally thought that the consuming industries have covered their requirements for several weeks ahead, and are not inclined to commit themselves to further forward purchases. So far as can be gathered, supplies to the Continent are not more than sufficient to meet immediate needs, and the price in neutral countries is well above the British official quotation. . . . As in other non-ferrous metal markets the position of spelter seems to be satisfactory. As there is no market in the general acceptance of the term it is of course difficult to estimate the position, but so far as can be seen supplies are plentiful excepting that there appears to be a tightness in the case of high-grade spelter. The control naturally concentrates upon maintaining the supply of spelter for national purposes and seems reluctant to provide metal for ordinary commercial work. As most consuming firms are employed upon work directly or indirectly concerned with Government contracts this does not cause much hardship. Quieter conditions have developed in the American market and after the active buying by consumers during the past few weeks it is not surprising that the volume of business has declined. The producers, however, are apparently pleased at the lull as they have sold heavily both for spot and forward delivery and the quiet period will give them an opportunity of overtaking their sales.

## French Engineering Notes

*(From our own Correspondent in Paris)*

### Skilled Hands for War Work

The whole of the nation's production for the prosecution of the war is organised by one man, Monsieur Raoul Dautry, and the thoroughness with which this is done leaves no doubt that the engineering industry will forge ahead more rapidly than it did during the last war. There is no appearance of a likely shortage of raw materials and other supplies, but a difficulty exists in procuring skilled hands in sufficient numbers to keep pace with a constantly increasing armament production. This shortage of skilled workers is mainly due to causes arising out of a long period of industrial depression, followed by changes introduced by labour politics when the unions got the upper hand and, for the time being, levelled up wages of lower paid workers in a manner that left no inducement for others to undergo years of apprenticeship without hope of making a profitable use of their skill in the future. This state of things has since been changed. Its effect, however, was to oblige the State to carry out plans for compulsory apprenticeship, and as they were not terminated when the nation had to concentrate on armament production, the plans have been adapted to the necessity of producing a constantly increasing supply of specialised workers who are needed in armament works and factories. Schools are being created all over the country for rapidly training men selected by employers from among unskilled workers showing an aptitude for the work they are required to undertake. They receive elementary technical instruction and then return to the works to complete their practical training. This method of training should give good results, for the average French worker is quick to learn, is adaptable, and has initiative, and a very large number of suitable men can be drawn from the unskilled ranks to help provide a continuous supply of specialised labour for armament production. These schools will also have classes for youths between 15 and 17 years of age who are capable of undergoing an intensive practical and technical training for particular trades during a period of a year or eighteen months. They will only enter a school after approval by a "professional orientation" committee. What is being done is, in fact, to introduce, for the duration of the war, an abridged form of the compulsory apprenticeship system with the object of obtaining a maximum number of specialised workers. As there is no full apprenticeship, this raising of men to skilled ranks is called the "workers' promotion." The longer the war lasts the greater will be the number of skilled workers of all kinds, for the most is being made of other training centres as well as of apprenticeship schools. This activity is indispensable for work of national defence. During that period there can be no surplus of skilled workers, nor is anyone disposed to forecast possible consequences of this engineering expansion, with its greatly increased skilled labour supply, when hostilities cease. It is easy to draw conclusions from what happened after the last war, but little need be said now beyond calling attention to the general feeling of economists and industrialists that everything possible must be done to retain and develop foreign trade so that the national economy may pass as smoothly as possible from war to peace conditions.

### Safety of Ships

Among decrees relating to the mercantile marine, one just published deals with precautions to be taken to ensure buoyancy and stability of ships as far as possible in the event of their being damaged, and thereby reduce navigation risks during the period of hostilities. While the London International Convention of 1929 continues to be applied with regard to bulkheads, further measures provide for a revised survey of the load line of ships' holds, and a strengthening of bulkheads, watertight doors, shaft tunnels, and double bottoms that do not appear to offer sufficient resistance to the pressure of water in a damaged hull. When a ship has not a full cargo, the holds fore and aft should be filled with materials of low density and permeability such as cork, barrels, and other empty and watertight packing receptacles. They should also be packed in spaces below the deck, immediately above the highest water line in the case of passenger ships and below the main deck of cargo ships. There should, of course, be no shifting of cargoes. When holds contain liquid ballast they must be either full or empty, unless the hold is divided longitudinally. A bulwark above the deck level is recommended. Each passenger or cargo ship must carry all the usual tools, appliances, materials, and quick-setting cement for stopping holes in hulls and carrying out temporary repairs. The Central Control Committee has now the task of seeing that every ship conforms to the instructions given in the decree for ensuring safety within the limit of possibilities.

### Rolling Stock

The National Railway Company was to have put in hand at the beginning of this year its five years' programme of orders for rolling stock. So much had to be done in preparing plans for standardising coaches and locomotives to new specifications that the giving out of orders was postponed, and a further impediment was the threat of war, and then the outbreak of hostilities. There is also a change in the composition of rolling stock through the suppression of first-class coaches, except on a few long-distance express trains, where they will remain in service until it may be found desirable to withdraw them. The distribution of orders is to begin almost immediately for 7500 goods wagons which are to be delivered during 1940. A firm in the Nord will build 120 tank wagons, and another order for 500 oil tank wagons has been placed with four makers in Belgium. There is a prospect of the order being renewed. The Belgian participation follows upon an arrangement recently made for increasing trade between the two countries. The programme for 1940 also includes 120 locomotives, the plans for which are not quite ready, but it is expected that an order for one-half of the number will be given out shortly.

## British Patent Specifications

*When an invention is communicated from abroad the name and address of the communicator are printed in italics.*

*When an abridgment is not illustrated the Specification is without drawings.*

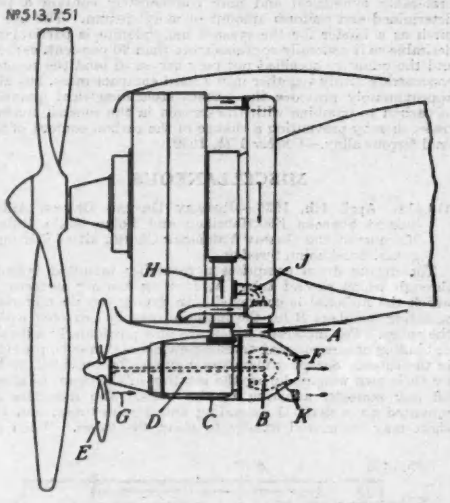
*Copies of Specifications may be obtained at the Patent Office Sales Branch, 25, Southampton Buildings, Chancery Lane, W.C.2 1s. each.*

*The date first given is the date of application; the second date, at the end of the abridgment, is the date of the acceptance of the complete Specification.*

### AERONAUTICS

513,751. April 19th, 1938.—IMPROVEMENTS IN POWER PLANTS FOR AIRCRAFT (a communication from *Aktiebolaget Milo, Kungsgatan* 32, *Stockholm, Sweden*).

In power plants for aircraft it has already been proposed to utilise the energy of the exhaust gases from the engine in a gas turbine which in addition to driving a compressor for supercharging the engine drives an auxiliary propeller. It is the object of this invention to provide for a more effective and simple auxiliary propulsion and more reliable and safe controlling means for varying the output of the compressor, to this end, at least part of the output of the turbine not used for driving the compressor is utilised to produce a propulsive reaction-effect for driving the aircraft. In the embodiment shown, the exhaust gases of the engine are supplied through a manifold to a conduit A which is connected to the inlet of a gas turbine B in a shell C, the turbine drives a compressor D and an auxiliary propeller E. The exhaust gases from the turbine are discharged rearwardly at a high velocity through a

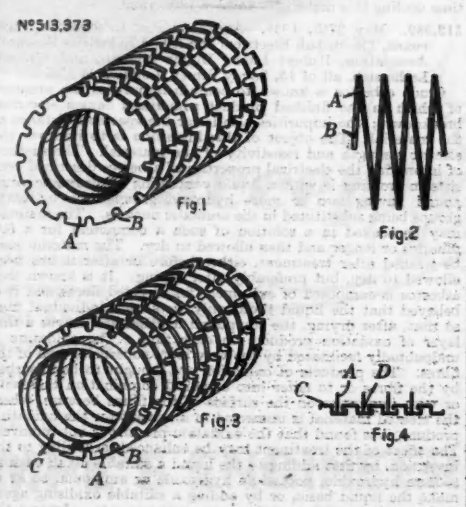



pipe F and thereby produce a propulsive reaction-effect which contributes to the propulsion of the aeroplane. Air is drawn into the compressor in the direction of the arrow G. After having been compressed to the desired value, a portion of the air flows through the conduit H to the engine for supercharging. By means of a conduit J, a portion of the compressed air is conducted into the conduit A, where it mixes with the exhaust gases and cools them to a temperature which can be safely utilised in the turbine. By means of a valve operated from the pilot's cabin, the amount of cooling air and consequently the temperature of the exhaust gases can be regulated to any desired value. Between the turbine and the outlet of the exhaust pipe there is connected a pipe K, provided with a control valve, the opening of which lowers the back pressure of the exhaust gases from the turbine, with the result that the propulsive reaction effect will be reduced and the input to the compressor increased. In this way, the amount of air compressed can be controlled to adjust the aggregate for different altitudes of flight.—*October 20th*, 1939.

### TRANSMISSION OF POWER

513,373. April 8th, 1938. ELECTRIC CABLES, Allgemeine Elektricitätsgesellschaft, of 2/4, Friedrich Karl-Ufer, Berlin, N.W.40, Germany.

Difficulty has hitherto been experienced in armouring thickened or enlarged portions of electric cables without depriving them of flexibility. Such portions are those in which

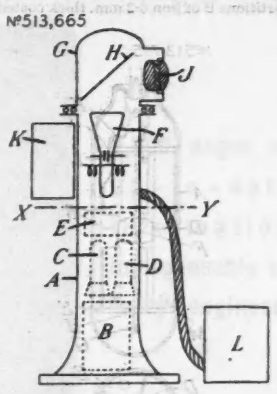



electrical apparatus is enclosed, for example the sleeves enclosing coils in marine cables. According to the invention such a thickened or enlarged part of a cable is rendered resistant to pressure by applying over it a helical spring made of wire of flat or other section and having in it external grooves or notches disposed helically and receiving the armouring wires. In all the figures the helical spring is denoted by A. It consists of a flat wire wound on edge. The helically disposed notches are denoted by B. In Figs. 3 and 4, C is a Z-shaped band from which the flexible metal pipe is made and D is the helical groove in it, into which groove the helical spring A is wound or screwed. The spring A or the pipe C with the spring A is or are applied over the coil sleeve or other enlarged part of the cable and the armouring wires of the cable are then placed in the notches B which, of course, have been so disposed as to suit the run of the armouring wires.—*April 8th*, 1939.

### MEASURING AND TESTING INSTRUMENTS

513,665. April 6th, 1938.—HIGH TENSION CATHODE RAY TUBE APPARATUS, Telefunken Gesellschaft fur Drahtlose Telegraphie m.b.H., of Hallesches Ufer 30, Berlin, S.W.11, Germany.

This invention applies to high tension cathode ray tube apparatus such as is employed for the reproduction of television signals or for the production of oscillograms. The high tension apparatus is mounted in a tubular casing A in the base of which there is a high tension rectifier comprising a transformer B, rectifying elements C and D, and smoothing means E. If necessary, the casing can be filled to the chain dotted line X-Y with oil. Above the line X-Y the casing contains a cathode

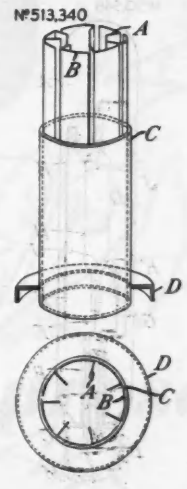



ray tube F provided with the usual fluorescent screen and the usual electrostatic or electro magnetic deflecting means. The head G of the casing has mounted therein an inclined mirror H and a projection lens J. The amplifier and the deflection circuits are arranged in a casing K outside the casing A and adjacent to the tube E. It is advantageous in the arrangement to make the head G of the casing rotatable so that the image produced by the tube can be projected in different directions. Instead of attaching the casing K containing the amplifier and deflecting circuits to the casing A, the amplifier and deflecting circuits may be placed on a stand or in a casing L separate from the casing A and connected to the latter by cable.—*October 18th*, 1939.

### FURNACES

513,340. April 8th, 1938.—ELECTRIC FURNACES, Det Norske Aktieselskab for Elektrokemisk Industri, of Kongensgate 18, Oslo, Norway.

This invention relates to electric furnaces of the kind employing self-baking electrodes. In such furnaces it has been proposed to form the electrode in a special iron mould which may be tubular and through which the electrode moves downwards, with or without the assistance of pressure, into the furnace. In the construction illustrated the sliding contacts comprise a series of radial rib-like parts A formed from iron plates of, say, 1 millimetre thickness, and each having a part B which lies approximately at right angles to the part B between the electrode mass and the inner surface of a mould C in which the electrode is formed so as to make good area contact with this mould. The mould C is provided at its lower end with a flange-like ring D which is connected to the roof of the furnace, for example, by a sand-lock or the like. In practice the mould is preferably water-cooled to the required extent adjacent to its



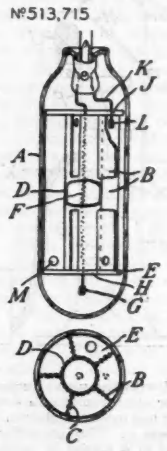

lower end and this tends to prevent coking or welding of the electrode or of the sliding contacts to the mould. The number of sliding contacts may vary and, if desired, only a single such contact may be employed, while further the width of the part B of each contact lying between the electrode mass and the mould in relation to the number of contacts may vary considerably. For example, the part B of each contact may, if desired, be so wide as completely or substantially completely to cover the part of the electrode surface between the parts B of the two adjacent contacts. Again, the radially extending rib-like part A of each contact may be reduced in size or even omitted. Each sliding contact must be capable of pressing the contacts outwards against the mould so as to make good electrical contact therewith and enable the mould to be completely filled so as to prevent escape of gas from the furnace through the mould. They must therefore not be attached so as to form a cylinder of fixed diameter. To this end it would theoretically be sufficient to have a single sliding contact encircling the electrode mass and having only a single longitudinal slit therein, but generally two or more separate sliding contacts are preferred. In

practice it is desirable to moisten the surface of the mould and of the sliding contacts with tar in the upper part of the electrode to assist in making the arrangement gas-tight, but this will not in general prevent sliding of the electrode and contacts in the mould. Part of the weight of the electrode mass, for example 30 per cent. to 50 per cent., is supported by friction from the mould. The remainder of, say, between 70 per cent. and 50 per cent. of the weight is conveniently carried by a hoisting winch connected to the upper ends of the sliding contacts A, B and so constructed that it can exert a downward pressure thereon if the friction in the mould should be so increased that the electrode tends to stick.—*October 10th*, 1939.

## LIGHTING AND HEATING

513,715. May 12th, 1938.—ELECTRIC DISCHARGE LAMPS, *The General Electric Company, Ltd., of Magnet House, Kingsway, London, W.C.*.

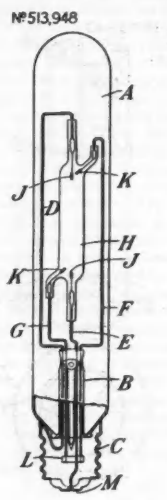
This invention relates to electric discharge lamps of the type wherein partitions subdividing the vitreous envelope enclosing the discharge force the discharge to pursue a path much longer than the straight line joining the electrodes. The purpose of the partitions is to enable compact lamps to be provided in which the voltage gradient along the discharge is small and yet the total voltage between the electrodes is not much less than mains voltage. A is a cylindrical glass envelope. There are five radial partitions B of iron 0·2 mm. thick coated with zirconia




C, sintered on. These partitions, which divide the envelope into five sectors, are carried on the central tube D, which may be of metal, coated with insulating material, or of insulating material. The sectors are closed at each end by coated metal or ceramic discs E. Within D is the resistor F serving as the stabilising impedance. One main electrode G is attached to the end of F below the lower disc E. Each disc has a hole H or J through which the discharge can pass to the lower electrode G, or the lead K carrying the upper electrode L can enter one sector. The partitions are pieced by holes M through which the discharge can pass from one sector to the next.—*October 19th*, 1939.

513,948. April 22nd, 1938.—METAL VAPOUR ELECTRIC DISCHARGE LAMPS, Siemens Electric Lamps and Supplies, Ltd., of Caxton House, Tothill Street, Westminster, London, S.W.1, and John Norman Aldington, of Siemens Electric Lamps and Supplies, Ltd., Dock Road, Preston.

The metal vapour electric discharge lamp described in this Specification is a 250 watt lamp suitable for use on mains having a voltage of 200–250. It comprises a tubular outer jacket A closed at one end and to the other end of which is attached a foot tube B and cap C. Within the envelope and supported therein by the rods, D, E, F, and G, is the discharge tube H, which may be of quartz. At each end of the tube H are two necks into which are sealed wires leading to the electrodes and connected to the rods D, E, F, and G. The main electrodes are designated J and consist of unactivated tungsten helices. An electrode suitable for the lamp illustrated may be made by




winding a tungsten wire ·1 mm. diameter on a tungsten mandrel ·35 mm. diameter, the helix so formed having a pitch of ·166 mm. The helix and its mandrel are then wound on a mandrel L·7mm. diameter and six turns of this close secondary helix are taken for the electrode. The helix is attached to a leading-in wire in known manner. In the other two necks are sealed wires leading to the auxiliary electrodes K. Each of these electrodes, which are situated close to the main electrodes, may consist of a tungsten helix of either a simple or secondary form enclosing a core of emissive material, *e.g.* alkaline earth oxide or silicate. The wires from the electrodes K are connected to the rods F and G, which are taken through the foot tube and joined to the two ends of a high resistance at L, a suitable value for this being 50,000 ohms. The wires from the main electrodes J are connected to the rods D and E which are also taken through the foot tube and joined, one to the cap C and the other to a contact M cemented into but insulated from the cap. The tube H has a filling of neutral gas such as argon and includes a quantity of mercury sufficient, when completely evaporated, to produce the desired vapour pressure. By the use of quartz for the tube H, a heavy loading may be employed with a consequent short running up period, thereby minimising distintegration of the electrode material. Vapour pressures used with this type of lamp may range from about 1 atmosphere to 15 atmospheres. Owing to the absence of activating material at the main electrodes, there is no sputter of emissive material, and the tube remains practically free from deposit and de-vitrification with a consequent improvement in the maintenance of the luminous output during the life of the lamp.—*October 26th*, 1939.

## METALLURGY

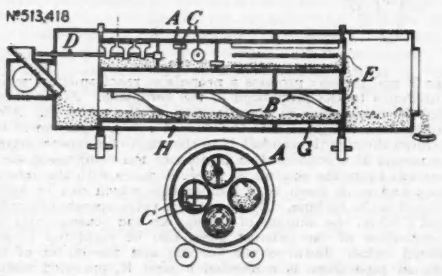
513,604. April 14th, 1938.—ALLOYING MOLYBDENUM WITH FERROUS METALS, Climax Molybdenum Company, 500, Fifth Avenue, City of New York, State of New York, United States of America, Assignees of Arthur Linz, 28, West 11th Street, New York, United States of America.

Molybdenum-bearing ferrous alloys have been produced by the addition of molybdenum to the iron or steel either as calcium molybdate, some other molybdic acid salt, or as ferro-molybdenum. However, each of these materials has its limitations and cannot be used universally for one reason or another. The invention has for its object the provision of a composition of matter for the introduction of molybdenum into ferrous alloys. There is provided for addition to a ferrous metal an alloying briquette consisting essentially of an intimate mechanical mixture of roasted molybdenite concentrates and a relatively small amount of a carbonaceous binder intimately mixed therewith. Roasted molybdenite, the commercial form of molybdenum trioxide, contains from 79 per cent. to 90 per cent. molybdenum trioxide. These briquettes have a relatively high specific gravity and are suitable for the production of ferrous molybdenum alloys either in the blast furnace, electric furnace, or by the addition of the briquettes to the molten metal in the ladle. The roasted molybdenite is mixed with a quantity of still-pitch which serves as a binder for the roasted molybdenite, and the proportions are such that the briquettes contain from 88 per cent. to 90 per cent. roasted molybdenite and from 10 per cent. to 12 per cent. of still-pitch. These briquettes are preferably cylindrical and may conveniently contain a predetermined and uniform amount of molybdenum. The use of pitch as a binder for the roasted molybdenite is particularly desirable as it generally contains more than 90 per cent. carbon, and the quantity specified not only serves to bind the roasted concentrate firmly together into a hard compact mass, but also approximately provides the correct stoichiometrical quantity of carbon to combine with the oxygen in the roasted concentrate, thereby preventing a change in the carbon content of the final ferrous alloy.—*October 17th*, 1939.

## MISCELLANEOUS

513,418. April 4th, 1938.—ROTARY DRYING DRUMS, Aktiebolaget Svenska Fläktfabriken and Folke Gösta Robert Magnusson and Gustav Valdemar Oholm, all of 8 Kungsgatan, Stockholm, Sweden.

The drying drum comprises a rotatably mounted cylinder through which extend tubes A, forming heating surfaces, in which the material is conveyed. In drying certain materials, agitating members B for the material may be provided within the tubes. For materials which are of a particularly adhesive or binding nature rotating crushing members C may be provided in the tubes. Scraping members may also be provided, to fall by their own weight during the rotation of the drum to scrape off any material adhering to the walls. The members are mounted on a shaft D extending outside the tubes, and this shaft may be moved axially to clean the tubes. When the



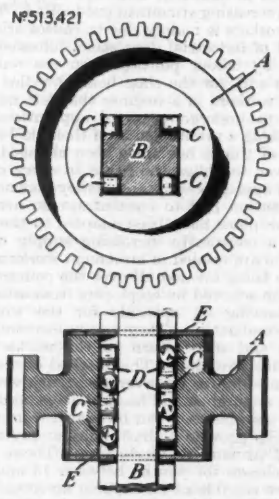

quality of the materials to be dried depends mainly on the regulation of the heat treatment, the quantity supplied to the apparatus may be controlled by regulating the size or number of the discharge openings E from the tubes. The dried material leaves the drum with a certain heat content which should be controlled in some cases, and it is possible to provide a cooling zone F formed as an extension of the main drying drum. Alternatively the latter part of the space as at G may be used for the cooling medium and the part H for the heating medium. A plurality of separate spaces such as G and H are provided around the tubes so that gases or liquids of different temperatures and at different pressures may be used for the drying and/or cooling treatments. Ventilation air, supplied to the drum, is preferably introduced into the cooling zone, and is pre-heated by the escaping hot material, whilst at the same time cooling this material.—*October 12th*, 1939.

512,589. May 27th, 1938.—ASBESTOS FOR ELECTRICAL PURPOSES, The British Electrical and Allied Industries Research Association, Hubert Lionel Digby Wyman, and William Lethersich, all of 15, Savoy Street, London, W.C.2.

Crude asbestos is known to contain impurities the presence of which in the finished product sometimes causes electrical breakdown; the impurities also lower the specific resistance of the material. The object of this invention is to improve the electric strength and resistivity of the material. The method of improving the electrical properties of asbestos described consists in treating it with a liquid containing an aromatic compound having two or more hydroxyl groups, the hydroxyl groups being substituted in the aromatic nucleus. The material may be soaked in a solution of such a compound for a few minutes or longer and then allowed to dry. The material may be washed after treatment, either before or after it has been allowed to dry, but preferably after drying. It is known that asbestos is composed of extremely fine-divided fibres and it is believed that the liquid thoroughly wets each individual fibre so that, after drying, the compound oxidises and leaves a thin layer of oxidation products on each fibre. The oxidation is undoubtedly facilitated by the very large superficial area of the fibres. The products of oxidation are thought to be adsorbed by the fibres or to enter into chemical combination therewith or with impurities on the surface of the fibres because, where the treated material is immersed in a solvent for the oxidation product, it is found that the oxidation product is not removed. The effect of the treatment may be enhanced, according to the invention, by first adding to the liquid a suitable alkali such as sodium hydroxide, potassium hydroxide or ammonia, so as to make the liquid basic, or by adding a suitable oxidising agent such as nitric acid or potassium permanganate. Among the organic compounds which may be used are pyrogallol, quinol, resorcinol, pyrocatechol, and phloroglucinol. In the case of certain chemical substances, such as pyrogallol and resorcinol, the excess compound should be washed out after the treatment of the material, and preferably immediately after the drying.—*September 20th*, 1939.

513,421. April 5th, 1938.—MOUNTING MEMBERS ON SHAFTS ROTATABLE THEREWITH, Coventry Gauge and Tool Company, Ltd., Fletchamstead, Coventry, Stanley Jaffa Harley, "Long Bend," Old Leamington Road, Stivichall, Coventry, and John Ernest Wainwright, 40, Berkeley Road, Coventry.

This invention relates to mechanism in which there is associated with a shaft and a member rotatable therewith a system of anti-friction bearing rollers arranged so as to prevent free relative axial movement between them and at the same time transmit a driving torque from one to the other. For precision work and delicate operations it is essential that the required relative axial movement between the shaft and the member shall at all times be as free as possible, and the object of the invention is to provide an arrangement for this purpose. Referring to the example illustrated in the drawing, A is a gear member adapted to transmit a driving torque to a shaft B arranged for axial movement relatively thereto. The gear has




a bore of square or rectangular cross-section, and the shaft is of a similar cross-section. Along each edge or corner of the shaft is formed a groove, the sides of which are parallel respectively with the sides of the bore opposite so as to form therewith square-section roller races between the shaft and the bore at each corner. Each of these square section roller races is adapted to receive a series of cylindrical bearing rollers C, arranged with their axes alternately at right angles to each other. The axial length of each roller is slightly less than its diameter so that whilst all the rollers function as anti-friction devices, alternate rollers, according to the direction of the torque applied, also transmit the torque across their diameters, the others being free to function as bearing rollers only. Spacing members D may be placed between the rollers, their bearing faces being preferably curved to suit the rollers. End plates E may be provided to prevent displacement of the rollers. Alternatively, the rollers may be free within the square section roller races, or they may be carried by any suitable type of cage.—*October 12th*, 1939.

## Forthcoming Engagements

*Secretaries of Institutions, Societies, &c., desirous of having notices of meetings inserted in this column, are requested to note that, in order to make sure of its insertion, the necessary information should reach this office on, or before, the morning of the Monday of the week preceding the meetings. In all cases the* TIME *and* PLACE *at which the meeting is to be held should be clearly stated.*

### Institution of Engineers and Shipbuilders in Scotland

*Tuesday, Dec. 19th.*—39, Elmbank Crescent, Glasgow, C2. "Humps and Hollows in Curves of Resistance," A. M. Robb. 6.30 p.m.

## PERSONAL AND BUSINESS ANNOUNCEMENTS

TURTON BROTHERS AND MATTHEWS Ltd., Sheffield, inform us that Mr. Arthur Sylvester Matthews and Mr. James Harold Jubb have recently been elected directors of the Company.

ENGINEER-CAPTAIN G. VILLAR was recently appointed as Engineering Works Manager at the Woolston Works of John I. Thornycroft and Co., Ltd., in succession to the late Mr. Robert Mackie.

THE ATLAS DIESEL COMPANY, Ltd., informs us that its offices, stores and works at King's Cross are now closed, and that the head office and works are now at Beresford Avenue, Wembley, Middlesex.

BURTON, GRIFFITHS AND CO., Ltd., Sparkbrook, Birmingham, 11, have been appointed sole selling agents in this country for the power presses manufactured by the V. and O. Press Company of Hudson, U.S.A.

## CATALOGUES

EVERSHED AND VIGNOLES, Ltd., Acton Lane Works, London, W.4.—A pocket book on earth testing.

SIEMENS BROTHERS AND CO., Ltd., Woolwich, London, S.E. 18. Catalogue No. 170.2 on joint box compounds.

N. TAYLOR AND SON, 50, Midghall Street, Liverpool, 3. A booklet on case hardening, with particular reference to "Hydro-Carbonated Bone-Black."

SIEMENS ELECTRIC LAMPS AND SUPPLIES, Ltd., 38 & 39, Upper Thames Street, London, E.C.4.—Brochures on "Sieray" electric discharge lamps and electric household appliances.

GENERAL ELECTRIC COMPANY, Ltd., Magnet House, Kingsway, London, W.C.2.—A book of over 330 pages describing the wide range of electrical equipment the company makes for ships.

NATIONAL ALLOYS, Ltd., Avonmouth. A revised edition of the "Mazak Manual," a booklet dealing in detail with the composition, properties, die casting, and finishing of the "Mazak" zinc alloys for die casting.

HERBERT MORRIS, Ltd., Loughborough. Book 197, dealing with the construction and uses of petrol-electric or oil-electric mobile cranes ranging from 1 to 6 tons, and not as previously stated in this column from 12 cwt. to 1¼ tons.